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USER'S GUIDE FOR COMBIMAN PROGRAMS (COMputerized Biomechanical MAN-Model) VERSION 5

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TECHNICAL REVIEW AND APPROVAL

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This report has been reviewed by the Office of Public Affairs (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER

CHARLES BATES, JR.
Chief
Human Engineering Division
Air Force Aerospace Medical Research Laboratory

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This User's Guide describes the procedures to operate the Air Force Aerospace Medical Research Laboratory's (AFAMRL) COMputerized BIomechanical MAN-model (COMBIMAN) programs. The Guide is based on the programs as of 1 May 1981. The Guide includes an introduction to the man-model and the conventions used to develop and analyze crew station configurations. It also deals with the operations of the operations of the programs included in the COMBIMAN system.

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These programs include the interactive graphics program CBM05, and the three key file creation/modification programs CBMAM, CBMCM, and CBMVM, which create and maintain the Data Bases of anthropometric surveys, crew station configurations, and visibility contour definitions respectively. The guide also contains a complete description of the use of CBMOFF, the off-line plot program.

The guide to operate the four main programs includes descriptions of the available processing for each program, definitions and examples of all input and output data formats, procedures to load the programs, and explanations of all diagnostic messages generated by the programs.

SUMMARY

This User's Guide describes the procedures to operate the Air Force Aerospace Medical Research Laboratory's (AFAMRL) COMputerized BIomechanical MAN-model (COMBIMAN) programs. The Guide is based on the COMBIMAN system of programs as of 1 May 1981. An introduction to the man-model and the conventions used to develop and analyze crew station configurations are included in the guide. It also contains the operations of the programs included in the COMBIMAN system. These programs include the interactive graphics program CBM05 to generate COMBIMAN, and the three key file creation/modification programs CBMAM, CBMCM, and CBMVM, which create and maintain the Data Bases of anthropometric surveys, crew station configurations, and visibility contour definitions respectively. The guide also contains a complete description of the use of the off-line plot program, CBMOFF. The first four programs are designed to run on an IBM 370 computer and CBMOFF is designed to run on a CDC Computer.

The guide to operate the four main programs includes descriptions of the available processing for each program, definitions and examples of all input and output data formats, procedures to load the programs, and explanations of all diagnostic messages generated by the programs. The requirements to run CBM05 and the available functions on the COMBIMAN are also described in the guide.

PREFACE

This work was performed under USAF Contract F33615-78-C-0507 entitled Biomechanics of Cockpit Evaluation. The government work unit number for this contract is 71840824. The contract monitor and technical advisor is Dr. Joe W. McDaniel of the Workload and Ergonomics Branch of the Air Force Aerospace Medical Research Laboratory. The development of the programs referred to in this User's Guide was performed by the University of Dayton Research Institute (UDRI). The UDRI Technical Report number for this Guide is UDR-TR-81-80.

The purpose of this report is to provide a detailed guide to use the key computer programs of the AFAMRL COMBIMAN system. It does not document the theoretical approach taken in developing any of the computer programs. The manipulation of the model and crew station is straightforward and the information in Section 2 will enable a non-computer person to run the interactive graphics program CBM05. Because of the technical nature of the plot program described in Section 3, and the data base maintenance programs described in Sections 4, 5, and 6, the person assigned to interpret and to use these programs should possess some experience in computer programming. Since all the programs are considered relevant to the COMBIMAN system, they are all included in this guide for sake of completeness. The description of the man-model and crew station in the introduction are presented as general background material needed to use the programs efficiently. The link-system described in the introduction is based on research originally performed by W. T. Dempster of the University of Michigan. Dr. K. W. Kennedy of AFAMRL/HEG contributed to the definition of the Anthropometric Data Base and provided significant improvements to the Dempster man-model link systems.

The authors would like to acknowledge the assistance and the technical support provided by Dr. Kenneth W. Kennedy and Mr. Charles Clauser of the Workload and Ergonomics Branch of the AFAMRL. In addition, the authors would like to thank Mr. John T. Moy of UDRI for programming effort and critical review and Ms. Charlene Thompson of UDRI for her patience while typing this User's Guide.

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SECTION 1
INTRODUCTION

During the design and analysis phases of crew station development, it is essential to assess the inadequacies and dangers of the crew station environment with respect to the human operator. The conventional method for accomplishing this has been to build mock-ups and use an undetermined number of "representative" test pilots to evaluate the work environment and control placement. The mock-ups tend to be costly and time consuming to build, as well as somewhat inflexible during testing. The sample size of the "representative" pilots depends on the availability of pilots and the whims of the designers.

The COMputerized BIomechanical MAN-model (COMBIMAN) system of programs has been developed to assist in the design and analysis phases of crew station development. It has been designed to serve as an interactive-computer-graphics-assisted engineering tool to represent geometric and physical properties of a person at a crew station. It has applications in evaluating conceptual or existing crew stations. The COMBIMAN is a three-dimensional man-model and can be viewed from any plane or angle. Since the man-model and crew station exist only on the Cathode Ray Tube (CRT) and in computer memory, no significant amount of time or materials are invested in making modifications. Alternative designs may be thoroughly evaluated and permanently recorded by a pictorial plot or a tabular printout of the crew station data and man-model (Joe McDaniel, 1974). Because of these capabilities, the COMBIMAN should reduce or eliminate the need for building mock-ups, as the designer can construct a crew station in three dimensions on a CRT and can assess interactions using man-models of various body sizes and proportions.

1.1 MAN-MODEL GENERATION

The man-model used in COMBIMAN is based on a 35 link-skeletal system. These links connect major points of rotation of the body segments as shown in Figure 1. The lengths of the links as well as their orientations with respect to their adjacent links in the skeletal system can be modified by the user. Since the segment lengths or link-lengths are generally internal dimensions and are difficult to measure on live subjects, the link lengths are derived from 12 readily measurable anthropometric surface dimensions. The sets of anthropometric variables available to users are highly correlated to mass or length of body segments. A more detailed description of these variables is given in Section 3. Section 2 describes the ways the user can change the proportions of the man-model by specifying new values for the surface dimensions.

There are three stages in generating the man-model. In the first stage, the link system is defined and generated using data available from tne Anthropometric Data Base and/or from data supplied by the user (see Figure 1). The other two stages use data supplied in stage one and data stored in the computer. The second stage places enfleshment ellipsoids about the link system joints as shown in Figure 2. In the third stage, the ellipses are connnected with tangent lines to define the contour of the man-model (see Figure 3). The user does not see these stages of model development; only the completed man-model is displayed.

The primary viewing planes for COMBIMAN are the X-Z plane (side view), the X-Y plane (top view) and the Y-Z plane (front view). The man-model need not be parallel to any one of these three orthogonal planes; it can be rotated by an angle with respect to these planes. Figures 1, 2, and 3 show COMBIMAN in the X-Z plane (side view).

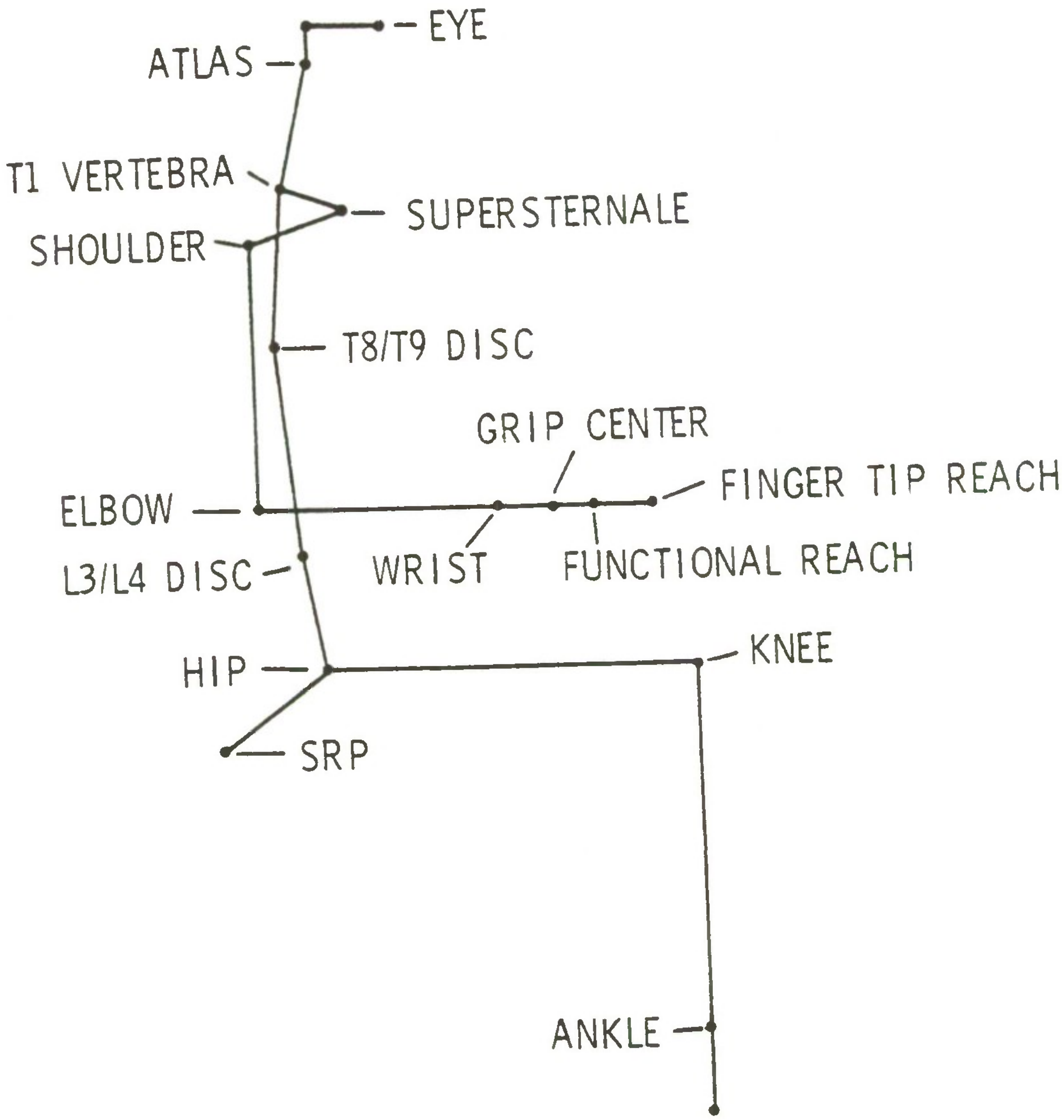


Figure 1. COMBIMAN Link System - Side View.

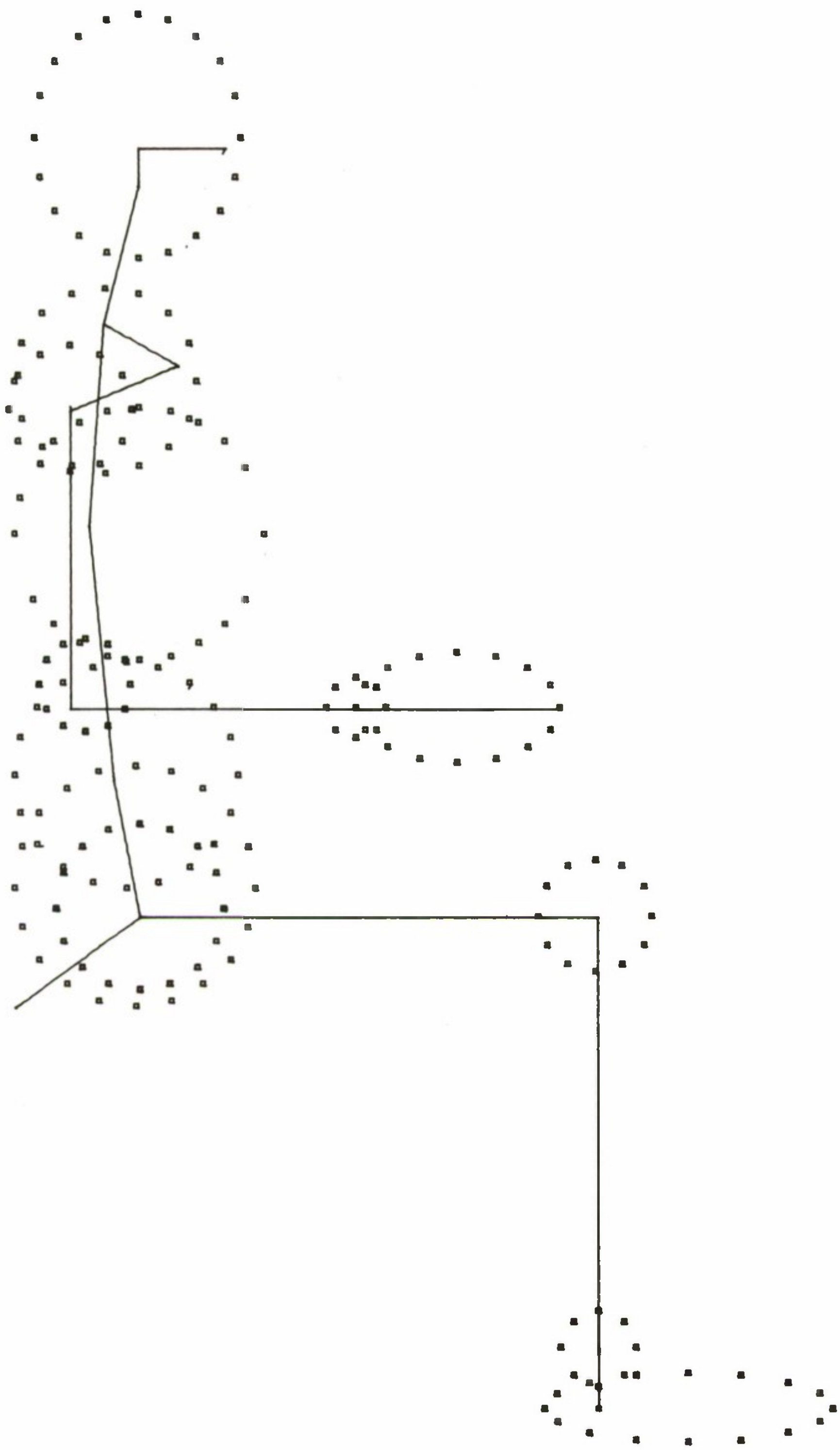


Figure 2. COMBIMAN Link System with Enfleshment Ellipses.

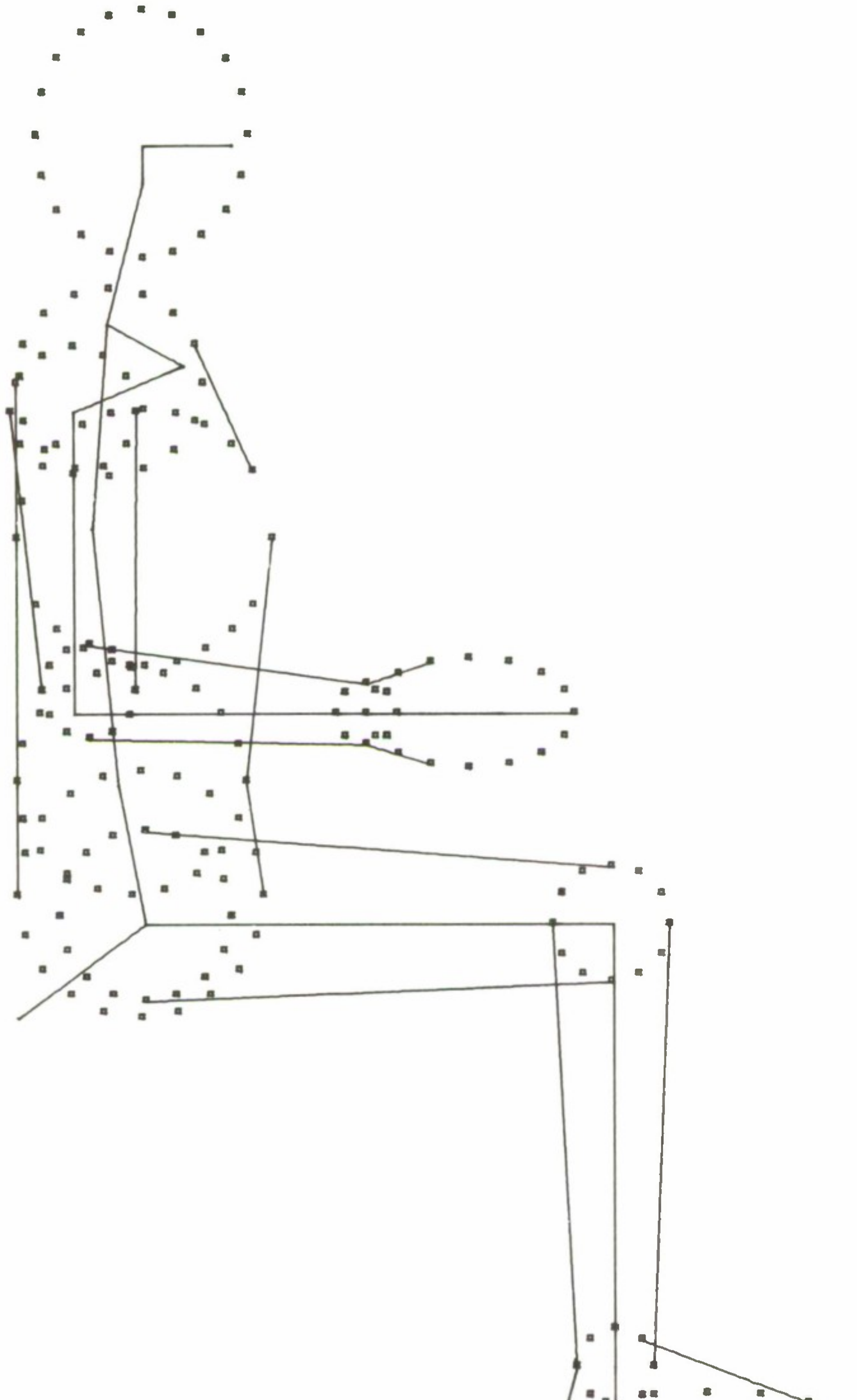


Figure 3. Enfleshed COMBIMAN with Tangent Lines.

1.2 CREW STATION DESIGN

Crew stations to be designed and evaluated using the COMBIMAN system consist of panels and controls. A crew station may have up to 250 planar panels with three to six vertices and 150 controls which may or may not be located on defined panels. Although the crew stations used in COMBIMAN are usually aircraft crew stations, it is possible to construct and display any workspace requiring interaction by a seated operator. This would include automobile instrument panels, industrial configurations, and control panels for other types of vehicles.

Two methods are used to generate and display crew stations. The designer can either use an existing or conceptual configuration, or can construct a new one on the Cathode Ray Tube using the available interactive graphic options. In the first method panels and controls for existing or conceptual configuration, are coded onto computer cards, or magnetic tape, or direct access disk, and are entered into the Crew Station Data Base. These data are accessed by the user through the interactive graphics program. In the second method, the user can design crew stations on the CRT, using alphanumeric keyboard and the program function keys, following the basic series of steps similar to those used on a drawing board.

A crew station entered into the program exists in three dimensions and the man-model can interact with it. Since the CRT has only two dimensions, the 3-D man-model and crew station are projected on the screen in the orientation selected by the user. The display can then be rotated within the Display Area to suit the designers' needs. An example of the display with a rotated man-model and crew station are shown in Figure 4. Note that the Roll, Pitch, and Yaw angles are displayed at the upper right hand corner of the display area.

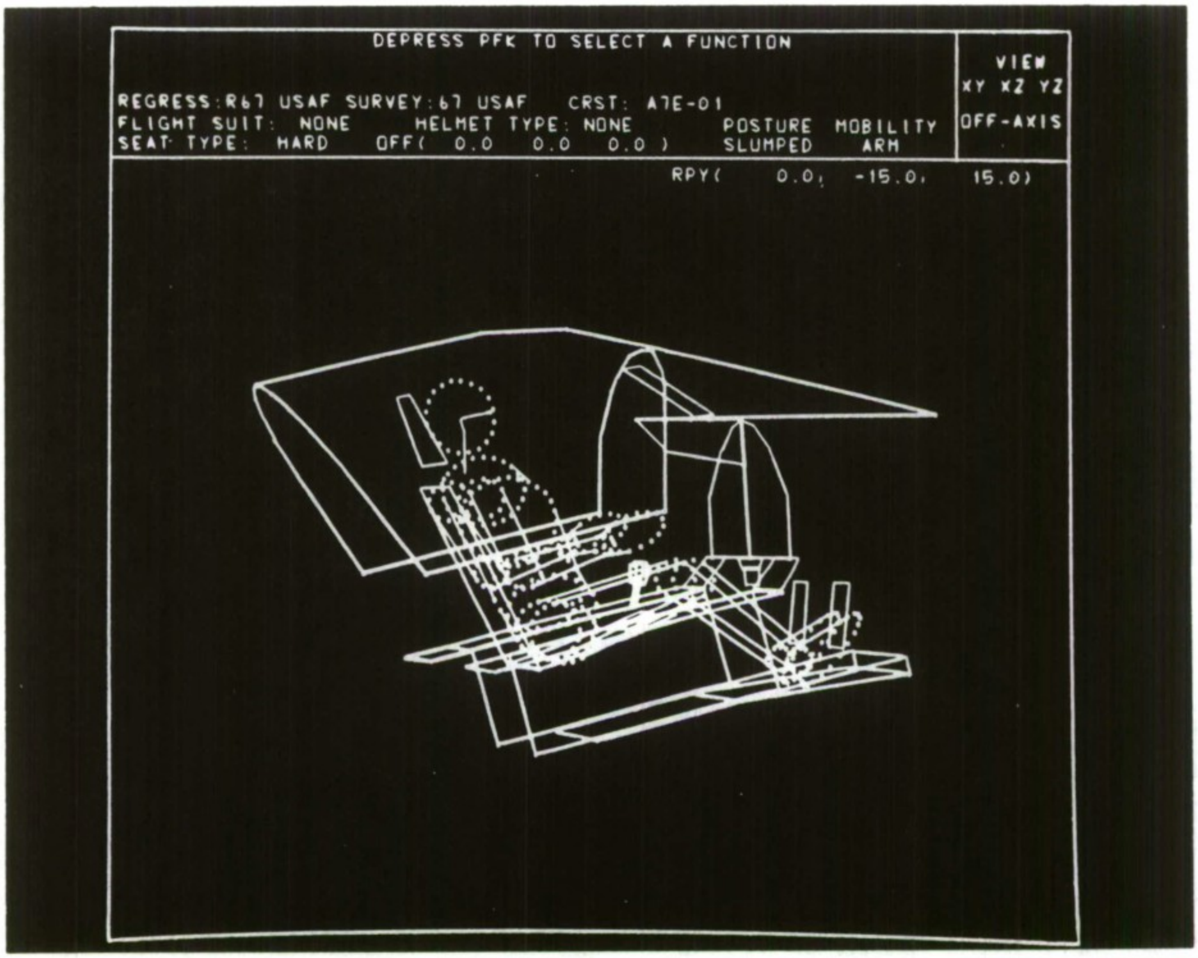


Figure 4. COMBIMAN CRT Display with Man-Model and Simplified Crew Station Rotated OFF-AXIS.

1.3 EVALUATION TECHNIQUES

A number of evaluation techniques have been implemented into the COMBIMAN system. They are designed to allow the user to vary the proportions of the man-model to suit a particular situation or problem, and to position the man-model within the crew station to assess human performance and to aid in placement of controls and panels.

In order to display the man-model on the CRT, the COMBIMAN uses data from on-line disk files and from user supplied data on anthropometric surface dimensions. The ability to make use of user supplied anthropometric data permits the construction of man-models of variable proprotions suitable to the particular needs of the user. To define the man-model, the program CBM05 (COMBIMAN program Version 5) requires values for the 12 anthrpometric variables to generate the 35 internal link lengths. The user can either supply values for all 12 variables or supply values for one mass-related and one length-related variable and let the program compute the other ten variables using multiple regression equations. The user supplied data may be (a) direct measures obtained from specific subjects; or (b) percentile values chosen from COMBIMAN Anthropometric Data Base. The latter option is generally the most useful, as it limits the range of values for user supplied dimensions and eliminates unrealistic combinations of dimensions. The program CBM05 may end abnormally when unrealistic combinations of anthropometric dimensions are supplied.

The man-model can be positioned in a crew station by directly entering sets of rotational angles used to position the links of the model, or with the PERFORM REACH ANALYSIS function (see Paragraph 2.2.11) by specifying a point on the display. The later method applies to reach involving the arms and incorporates automatic restrictions to mobility. The user may also

initialize the man-model in the standard anthropometric seated measuring posture (ERECT POSTURE), the SLUMPED POSTURE, which is an erect posture positioned in a 13 degree seat back angle and six degree seat pan angle, or a third posture (PRGM'D POSTURE) interactively designed by the user.

Other information available to the user includes hard copy plots of the display, printed output showing the three dimensional real world coordinates of the man-model and of the panels of the crew station, and visibility plots, which give the user information on the visual field of the crew station based on the eye position of the man-model.

1.4 THE COMBIMAN PROGRAMS

The COMBIMAN system is divided into five programs, the main program being the interactive graphics program CBM05, which allows the user to generate a variable size man-model and to assess its interaction with new or existing crew stations. Before the user can define the proportions of the man-model, or call up crew stations and visibility contours for evaluation, the files which store the anthropometric, crew station, and visibility member data must be created. This is done by using three specialized file creation/modification programs, each dealing with a particular type of data set: anthropometric, crew station, or visibility member. Similar sets of commands are used by each program to initialize the file, to add or delete data, to write existing data groups to the printer, or to punch data groups to cards. The data flow of the COMBIMAN program is shown in Figure 5. Figure 5 also shows a fourth file, the initialization data set, which contains data used to construct the man-model and cannot be modified by the user.

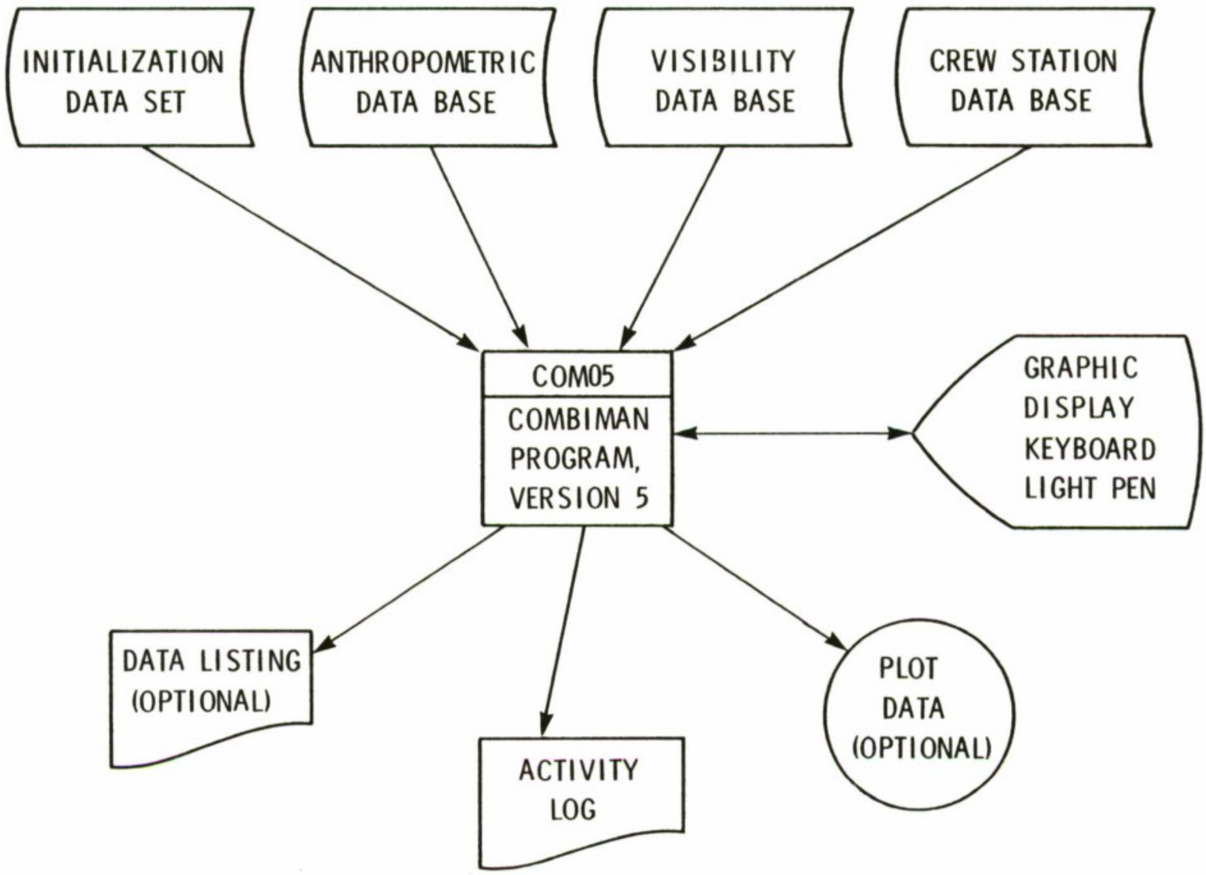


Figure 5. Data Flow in the COMBIMAN Program.

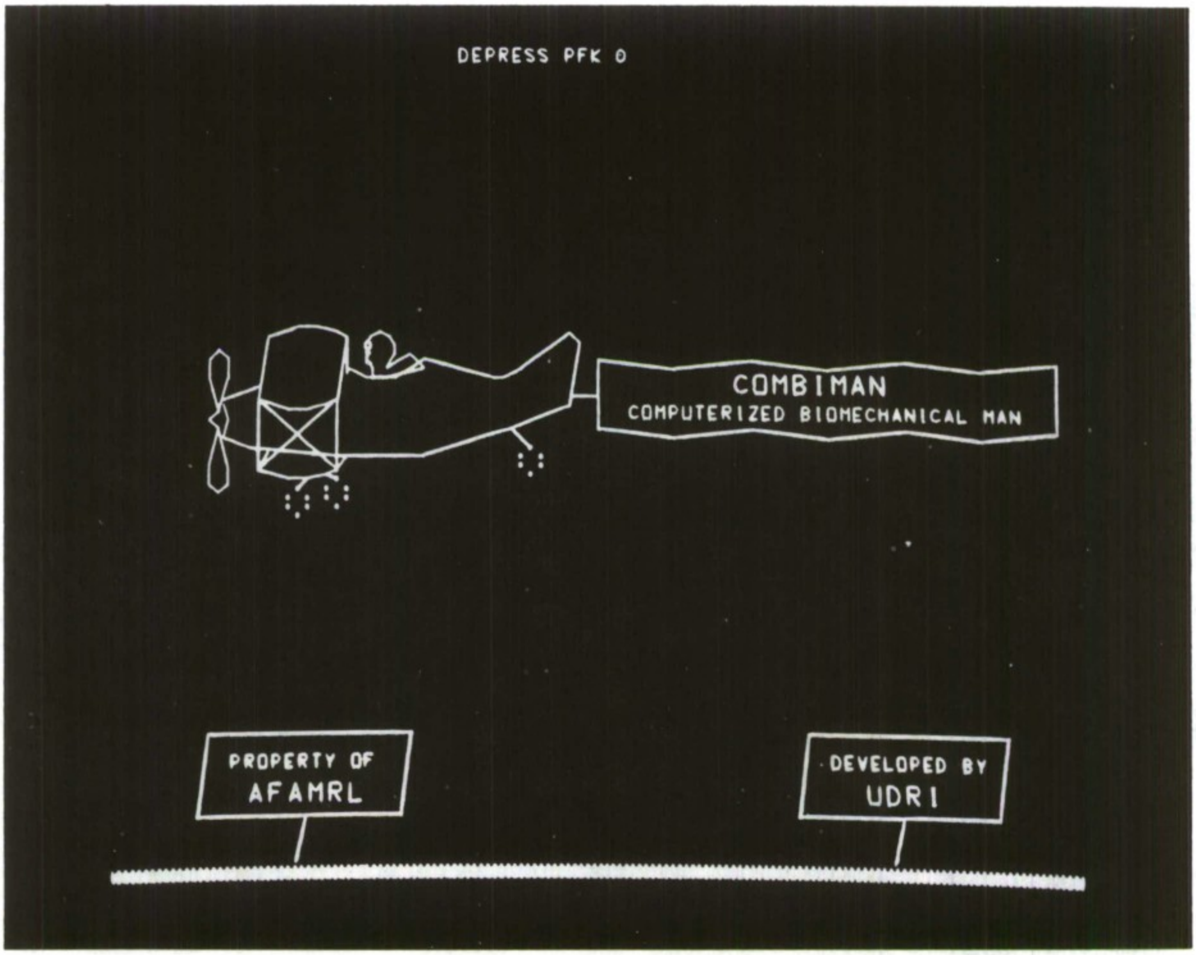
The following sections explain the operation of five key programs of the COMBIMAN system, including the interactive graphics program CBM05, the off-line plot program CBMOFF, and three of the file manipulation programs which maintain the data files used as input to CBM05. The manipulation of the man-model and crew station using CBM05 is straightforward. Sections 1 and 2 of this guide provides a designer not skilled in computer programming with sufficient information to use CBM05 interactively. Due to the technical nature of the data and operations described in Sections 3, 4, 5, and 6 some computer skill is required to interpret and use these programs.

Section 2 describes the use of the program function keys which may be activated by the user in program CBM05 to manipulate the man-model and to design and evaluate crew stations. This section includes examples of optional as well as standard output formats supplied by the program, and lists possible error or information messages generated by the program.

Section 3 describes the COMBIMAN off-line plotting program, CBMOFF. This program uses data generated by CBM05 to produce plots of variable size, color, and content from the three-dimensional coordinate data. Input formats, plotting options, and program output are explained in this section.

The program which creates and maintains the Data Base containing the Anthropometric surveys, CBMAM, is documented in Section 4. The types of stored data, the sources for such data, and the formats for data input, sample output, and action and error messages are discussed. The uses of, and formats for, the commands or functions which manipulate the file as well as the data are also described.

The program which creates and maintains the Data Base containing the geometric descriptions of crew station configurations, CBMCM, is documented in Section 5. The program which creates and maintains the Data Base of geometric descriptions of crew stations for visibility plots, CBMVM, is documented in Section 6. Data sources and formats for input, output, and messages are also described for both programs. In addition, these sections contain examples of Job Control cards to run these programs.



BEGINNING OF COMBIMAN PROGRAM

SECTION 2

THE COMBIMAN INTERACTIVE GRAPHICS PROGRAM VERSION 5 - CBM05

At the heart of the COMBIMAN system is the fifth version of the COMBIMAN interactive graphics program CBM05. The program uses an IBM 2250-3 Display Unit for designing and analyzing crew station configurations. The user at the display device controls the course of execution of program CBM05 using a Program Function Keyboard, ,a light pen, and an alphanumeric keyboard. Functions of the program are executed by depressing lighted Program Function Keys. This section describes the functions available to the COMBIMAN user, shows the output these functions generate, and traces through suggested execution sequences to generate the man-model, and to retrieve a crew station.

2.1 INTRODUCTION

The graphics program CBM05 enables the designer to bring together the information on anthropometry and crew stations stored on disk (see Sections 4 and 5) and to combine them with the interactive qualities of the Cathode Ray Tube. This enables one to evaluate real-life conditions, or to establish design criteria for new situations in a fraction of the time it would take using conventional methods.

For design and evaluation sequences, the 12-inch square CRT screen is partitioned into Prompting, Information, and Display areas (see Figure 6). The Prompting Area displays messages indicating what the user should do next. This area is also used to accept replies through alphanumeric keyboard when

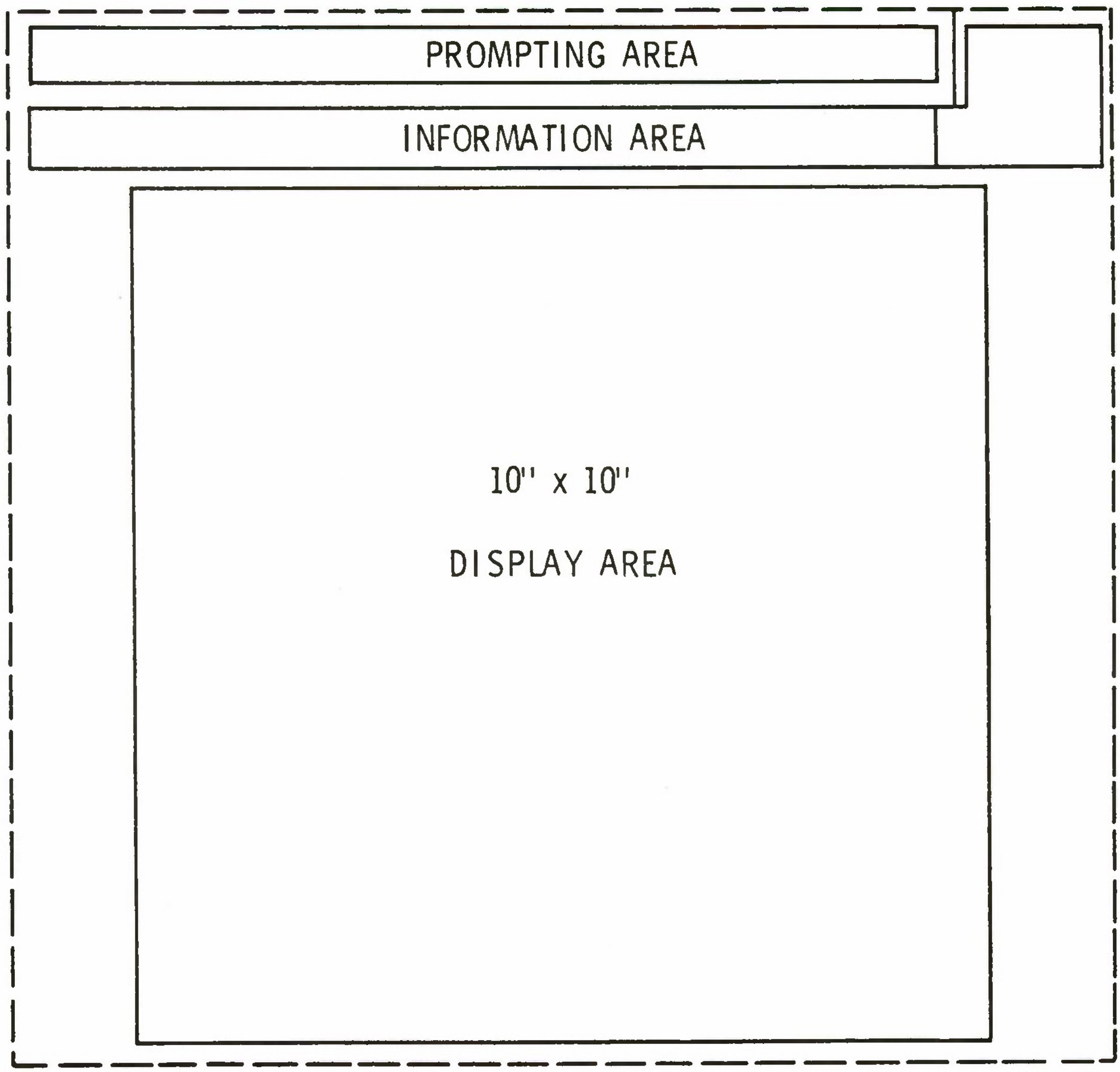


Figure 6. Format of IBM 2250-3 Display Unit. The program adjusts the size of the displayed image to fill the 10" x 10" display area. Selecting a front view may cause the man-model and crew station to appear larger, but the coordinate information remains unchanged.

requested. The Information Area displays the anthropometric survey name, the crew station name, flight suit and helmet types, seat type and offset, mobility, and posture information. The 10-inch square Display Area is used to display the man-model, crew station and roll, pitch and yaw angles, if different from zero. The three dimensional coordinates of the reach point during Reach Analysis, the coordinates of the current vertex during a panel design, and the visibility member names during Visibility Plot Functions are also displayed in the Display Area.

Replies to prompting messages are given through the Alphanumeric Keyboard (ANKB), the Light Pen, or the Programmable Function Keys (PFK). Replies given through ANKB are displayed in the Prompting Area below prompting message and are processed by the program after simultaneously depressing the ALT CODING key and the "5" key.[1] A light pen reply is given by aiming the light pen beam at the desired response displayed on the CRT, and depressing the light pen barrel against the screen.

Figure 7 shows an IBM 2250-3 CRT in use. The user's left hand is on the Program Function Keyboard, and his right hand is using the light pen to identify a point on the screen. The Alphanumeric Keyboard is shown below the CRT.

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[1]In subsequent use in the text the simultaneous depression of the "ALT-CODING" and "5" keys will be referred to as the ALT-CODE/5 sequence. IBM refers to this sequence as EOB (End of Block). (IBM System Reference Library, Program Numbers 360S-LM-537.)

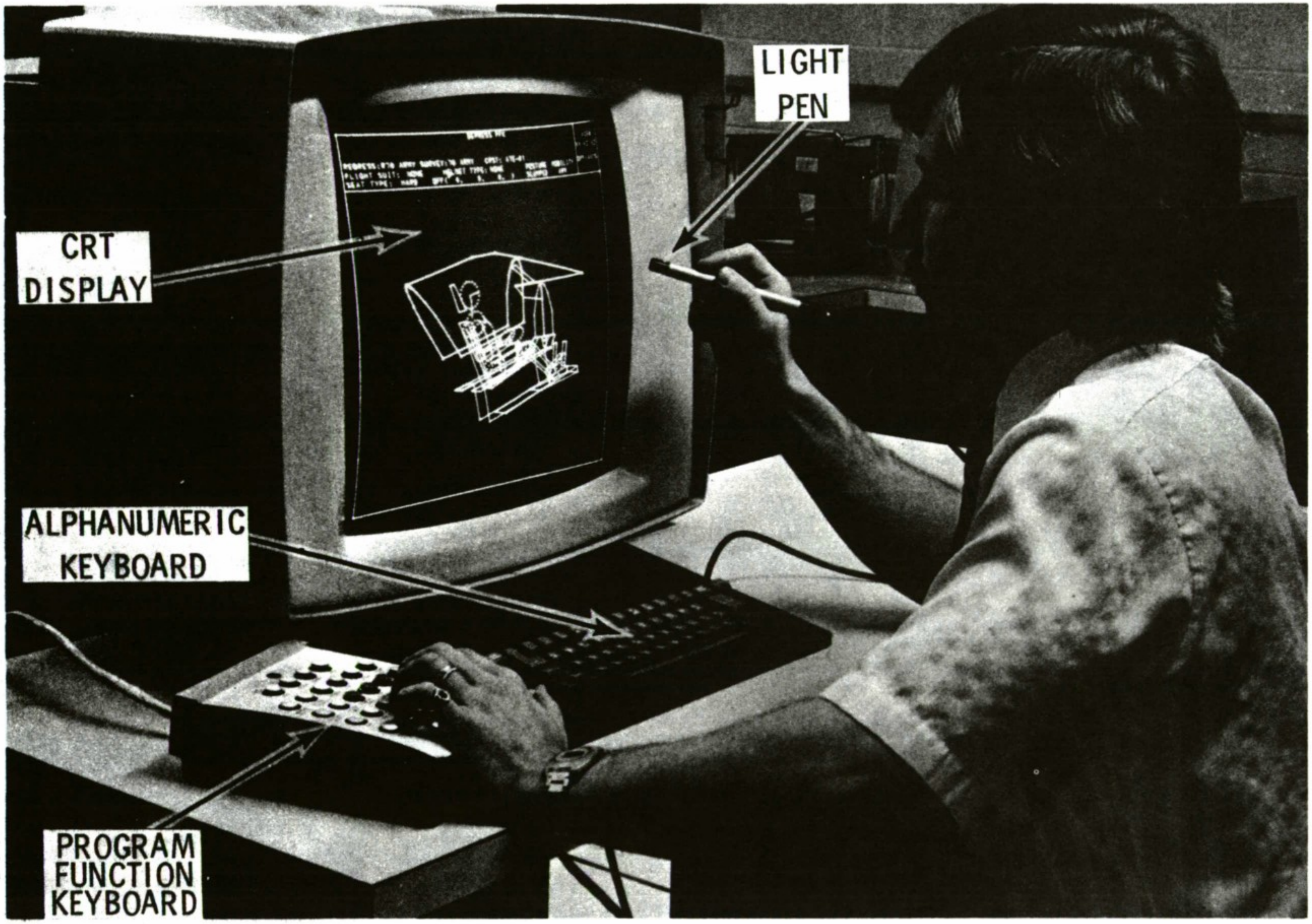

Figure 7. CRT Unit with Function Keys, Alphanumeric Keyboard and Light Pen.

2.1.1 Available Functions

The functions which are available to users fall into six basic categories, as shown in Figure 8. The first category, the Anthropometry Related functions, enables the user to retrieve data for a particular anthropometric survey from the Anthropometric Data Base, specify values for the surface dimensions of the man-model, and manipulate the geometry of the model to achieve the desired man-model configuration. The Crew Station-Related functions allow the user to retrieve existing three-dimensional crew station configurations from the Crew Station Data Base and then add to and modify the retrieved configuration. These functions allow users to start from the beginning of a design sequence and create a new crew station configuration. The Display-Related functions allow users to rotate and to magnify the contents of the display area. They also enable users to identify objects within the Display Area, or modify the contents by omitting or by including objects. The user can evaluate the interaction of man-model with crew station through the Man-Machine Interaction Related functions. These functions provide users with a reach analysis routine and change posture functions. The Printer/plotter Related functions supply users with hardcopy output of the configuration of either the man-model or the crew station. The program generates plot output as soon as a plot function is activated, but the printed output occurs only at the end of the run. The final category, the Program Execution Related functions, permits the user to restart the program, or to end it. It also enables the user to set State Switches which either suppress or activate additional processing or printing.

A standard feature of the program is a listing of all actions taken by the user. This listing is a sequence of messages printed at the termination of the program CBM05.

ANTHROPOMETRY-RELATED	CREW STATION-RELATED	DISPLAY-RELATED
Retrieve Anthropometry Enter Twelve Dimensions Enter Two Key Dimensions Display Link Table	Retrieve Crew Station Design Panel Delete Panel Adjust Seat	Change View Identify Object Omit Object Include Object Change Perspective Zoom
MAN-MACHINE-INTERACTION RELATED	**PRINTER/PLOTTER-RELATED**	**PROGRAM-EXECUTION RELATED**
Perform Reach Change Posture Reset Roll, Pitch, Yaw	Print Data Plot COMBIMAN Generate Visibility Plot Dump CRT on Plotter	Set State Switch Restart CBM05 End CBM05

Figure 8. Functions Available to COMBIMAN User.

2.1.2 Requirements

At the Wright-Patterson Air Force Base, AFAMRL HESS facility, the program CBM05 runs on an IBM 370/155 Operating System Computer using an IBM 2250-3 graphics display terminal with light pen, alphanumeric keyboard, and program function keyboard, and an on-line Gould 5000 potter. The program requires 550K bytes computer memory and a minimum of 20K bytes graphics buffer control area. The Initialization, Anthropometric, Crew Station and Visibility Data Bases reside on a disk drive in a direct access format. The space requirement for each data base depends on the number of members and their complexities. IBM System/360 Operating System Graphic Subroutine Package (GSP) for FORTRAN IV is used to create displays on the CRT. Gould 4800/5000 IBM System/360/370 Plot package is used for on-line plotting.

Other requirements for specific functions are described in the appropriate paragraphs which follow.

2.2 AVAILABLE PROCESSING

Functions of Program CBM05 are requested by means of the Program Function Keyboard. This keyboard consists of 32 keys, numbered 0 to 31, whose functions are assigned by program CBM05. When a function is enabled, the appropriate button on the PFK will be lighted. The primary functions for Program CBM05 are shown on the PFK Overlay Mask in Figure 9. The circles in Figure 9 represent the PFKs. Their numbers are shown above and to the left of each circle. The numbers within the circles represent the subsections where the functions are described. For example, PFK0 contains a "1" within the circle and is described in Paragraph 2.2.1. A function is requested by a single, momentary depression of the corresponding PFK.

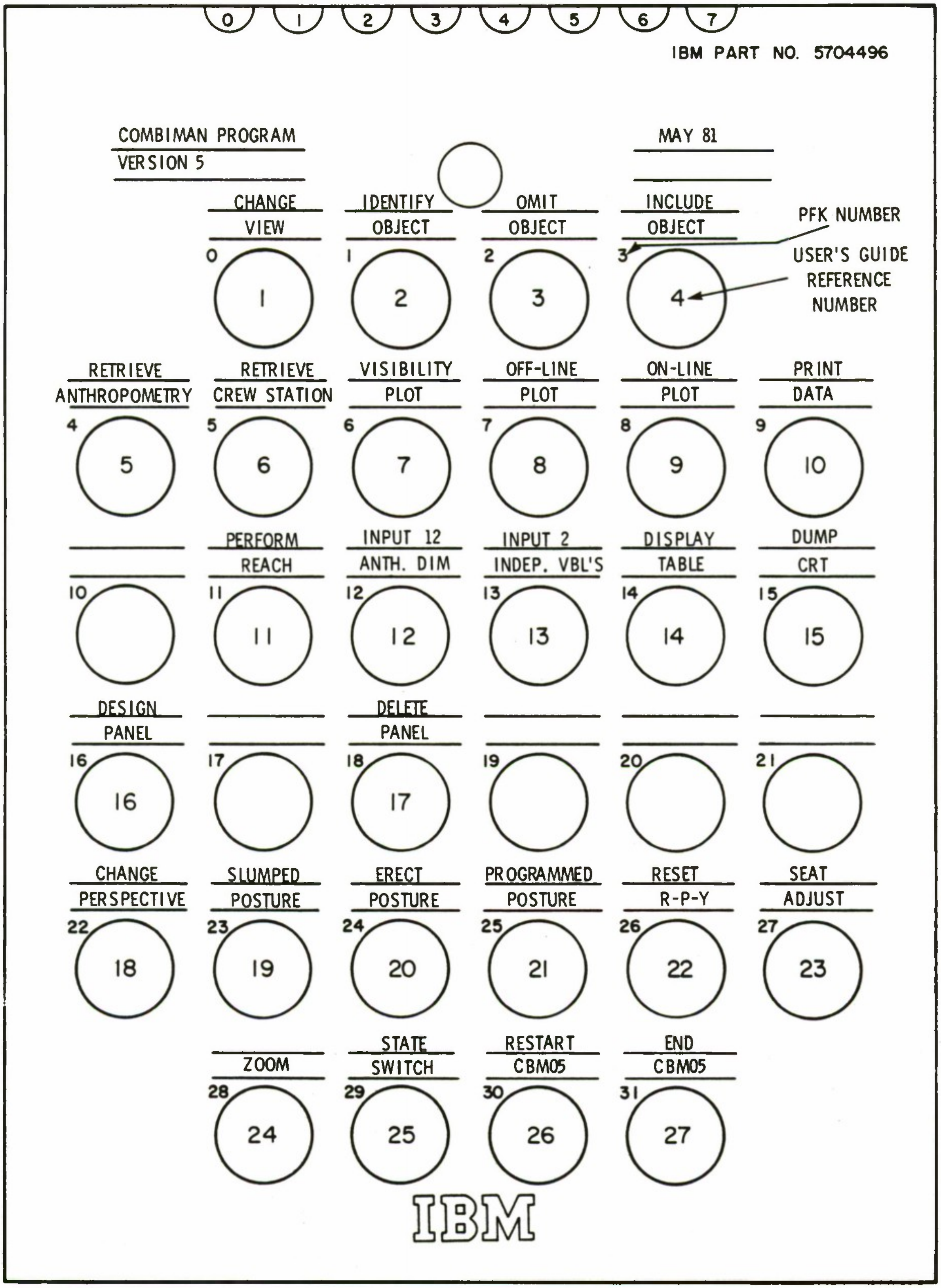

Figure 9. Program Function Keyboard (PFK) Overlay for Program CBM05.

Once the program is loaded (for instructions on loading, see Paragraph 2.3.1) the prompting area of the screen will display the message "DEPRESS PFK4 TO SELECT ANTH DATA". The first sequence of steps the user follows should utilize Anthropometry Related functions to generate the man-model. The mandatory sequence is shown in Figure 10. The number in each block refers to the paragraph which describes the function.

After the man-model is generated and displayed on the CRT, the user may choose to manipulate the man-model using the Display-Related functions, or may retrieve or develop a crew station using the Crew Station Related functions. (Should be selected before deleting panels.) The Program Execution Related functions (see Figure 8) are always enabled and may be depressed at any time during the execution of CBM05.

The following paragraphs describe the processing performed by each function as numbered in Figure 9.

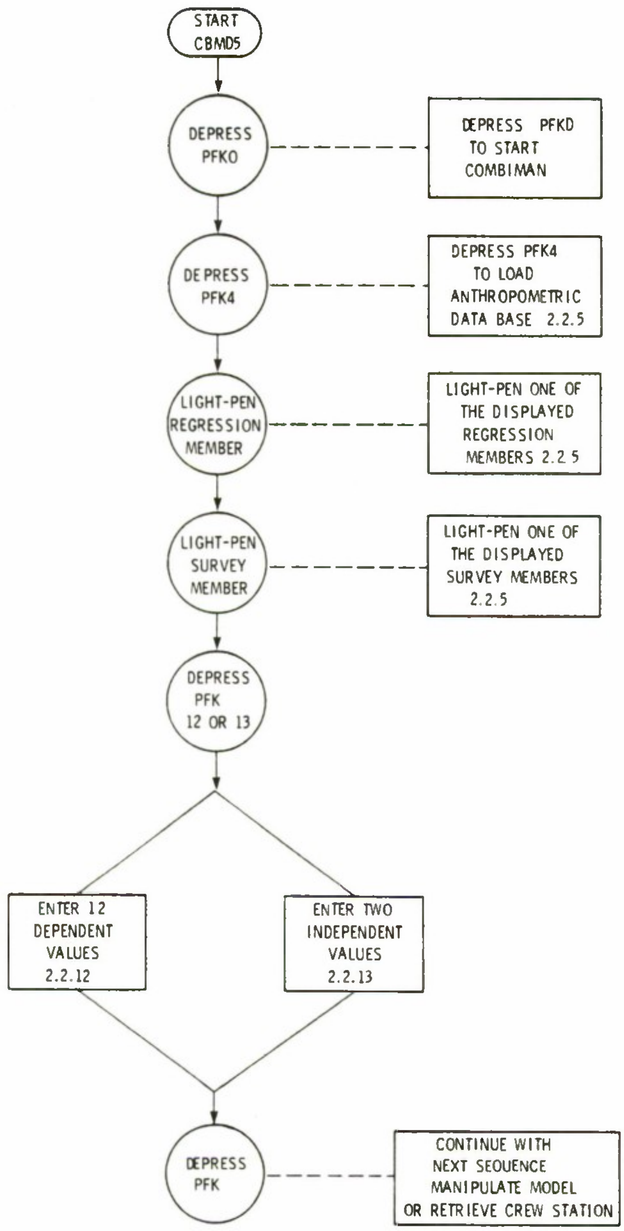

Figure 10. Function Sequence for Generating the Man-Model.

2.2.1 CHANGE VIEW Function (PFK0)

The CHANGE VIEW function allows users to rotate the man-model and the crew station in the display area of the screen as shown in Figure 6.

Once this function key is selected, the program prompts the user to select either a new view-plane for the display area, or to define a new off-axis orientation of the man-model and crew station. To change the view-plane, the user responds to the message "L.P. VIEW CHANGE" by light penning "XY" for a top view, "XZ" for a side view, or "YZ" for a front view of the man-model and crew station. Then the program regenerates the display in the new view-plane. Figures 11, 12, and 13 show the display of COMBIMAN in the A7E-01 cockpit in the XY (top), XZ (side), and YZ (front) view-planes respectively.

If the user responds to the message "L.P. VIEW CHANGE" by light penning "OFF-AXIS" in the upper-right corner of the screen, the program prompts users to enter the new roll, pitch, and yaw angles. Angles are specified from the ANKB in degrees by typing the value and following the ALT-CODE/5 sequence. The default value, 0 degree for these angles, is entered by simply depressing the ALT-CODE/5 sequence. The following sequence of replies rotates the man-model and crew station of Figure 12 to ROLL = 10 degree, PITCH = 0 degree, and yaw = -15 degree.

10	(Change ROLL to 10 degree)
ALT-CODE/5	(Enter ROLL = +10 degree)
ALT-CODE/5	(Enter PITCH = 0 degree)
-15	(Change YAW to -15 degree)
ALT-CODE/5	(Enter YAW = -15 degree)

Once the ALT-CODE/5 sequence for the YAW angle is entered, the display will be rotated.

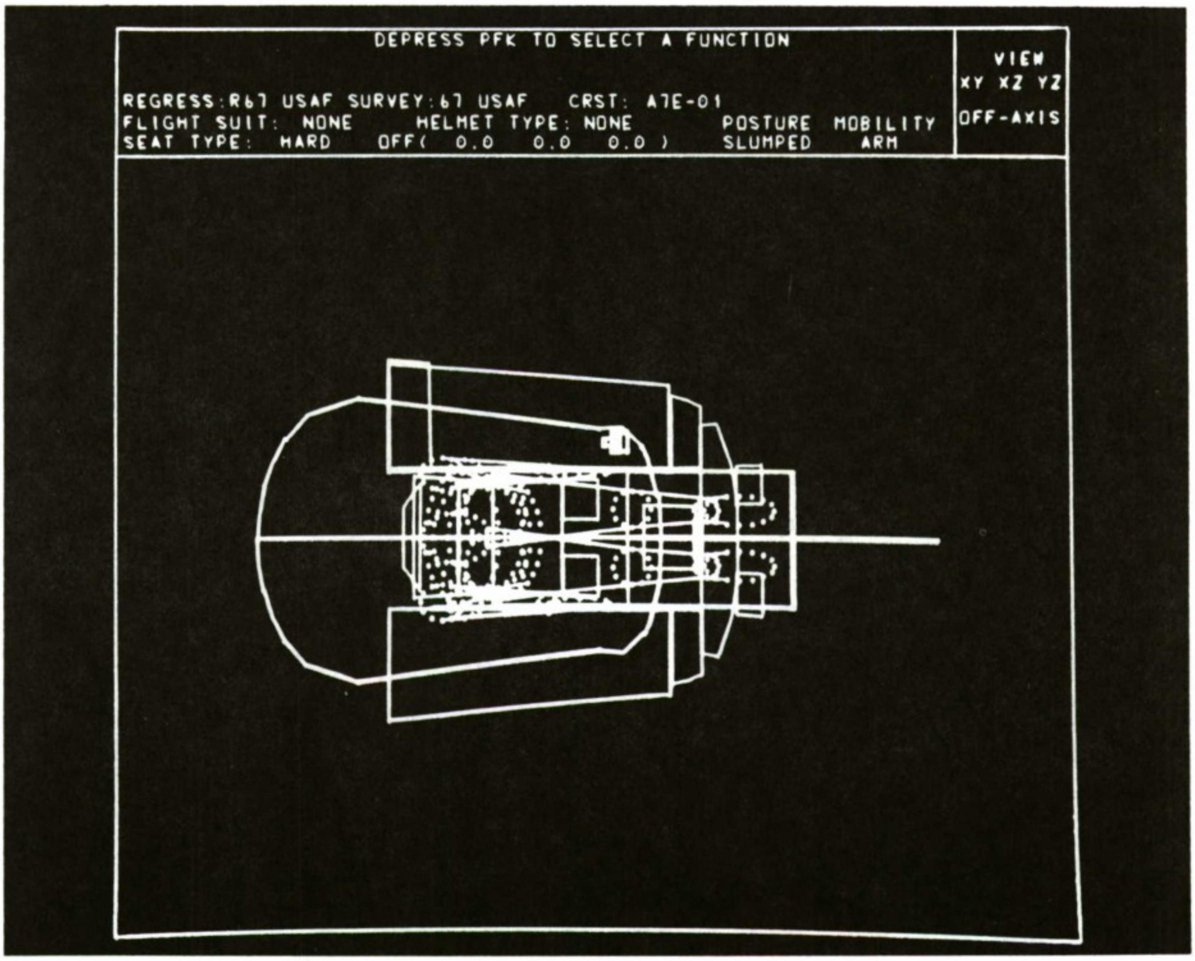

Figure 11. Top View (X-Y Plane) of the Man-Model and a Crew Station.

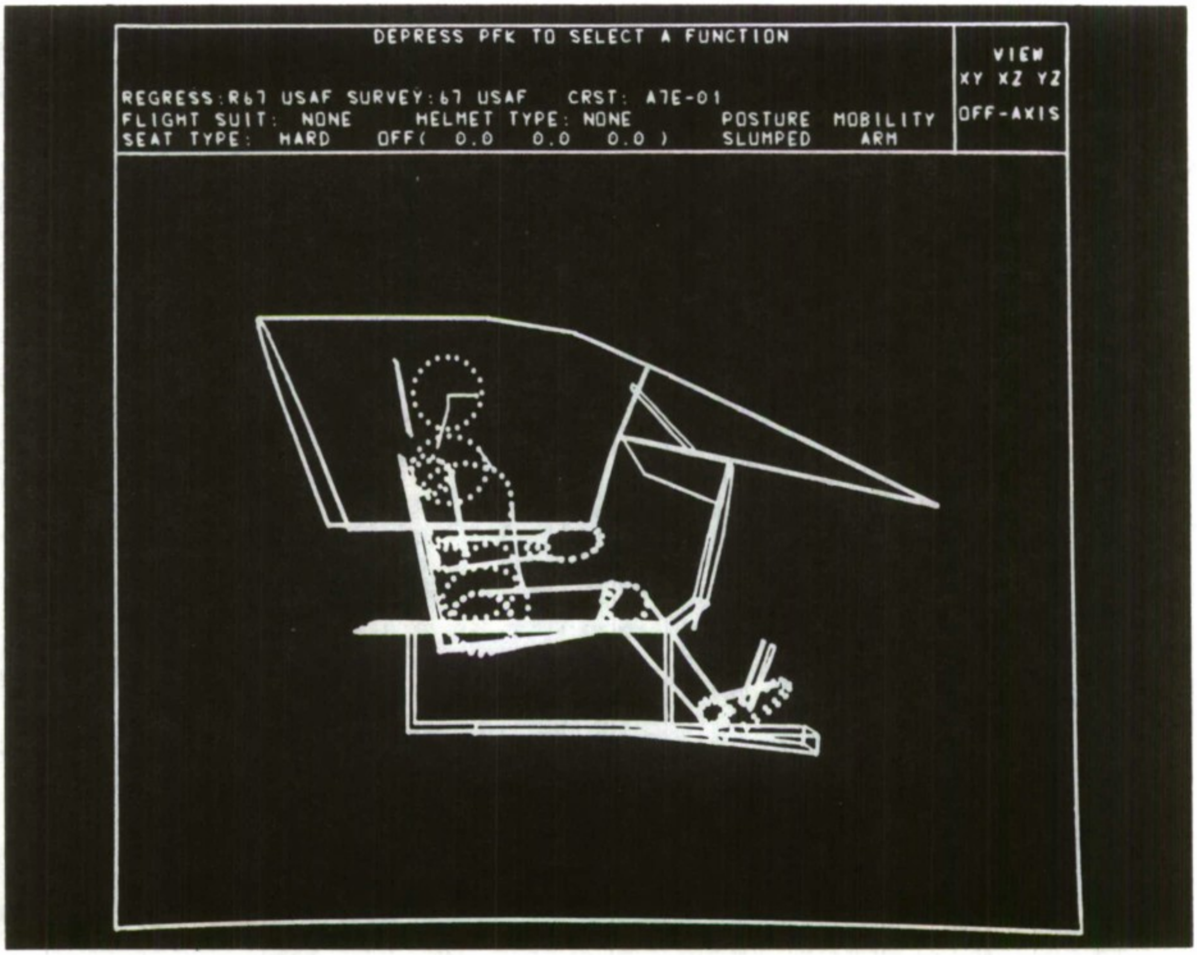

Figure 12. Side View (X-Z Plane) of the Man-Model and a Crew Station.

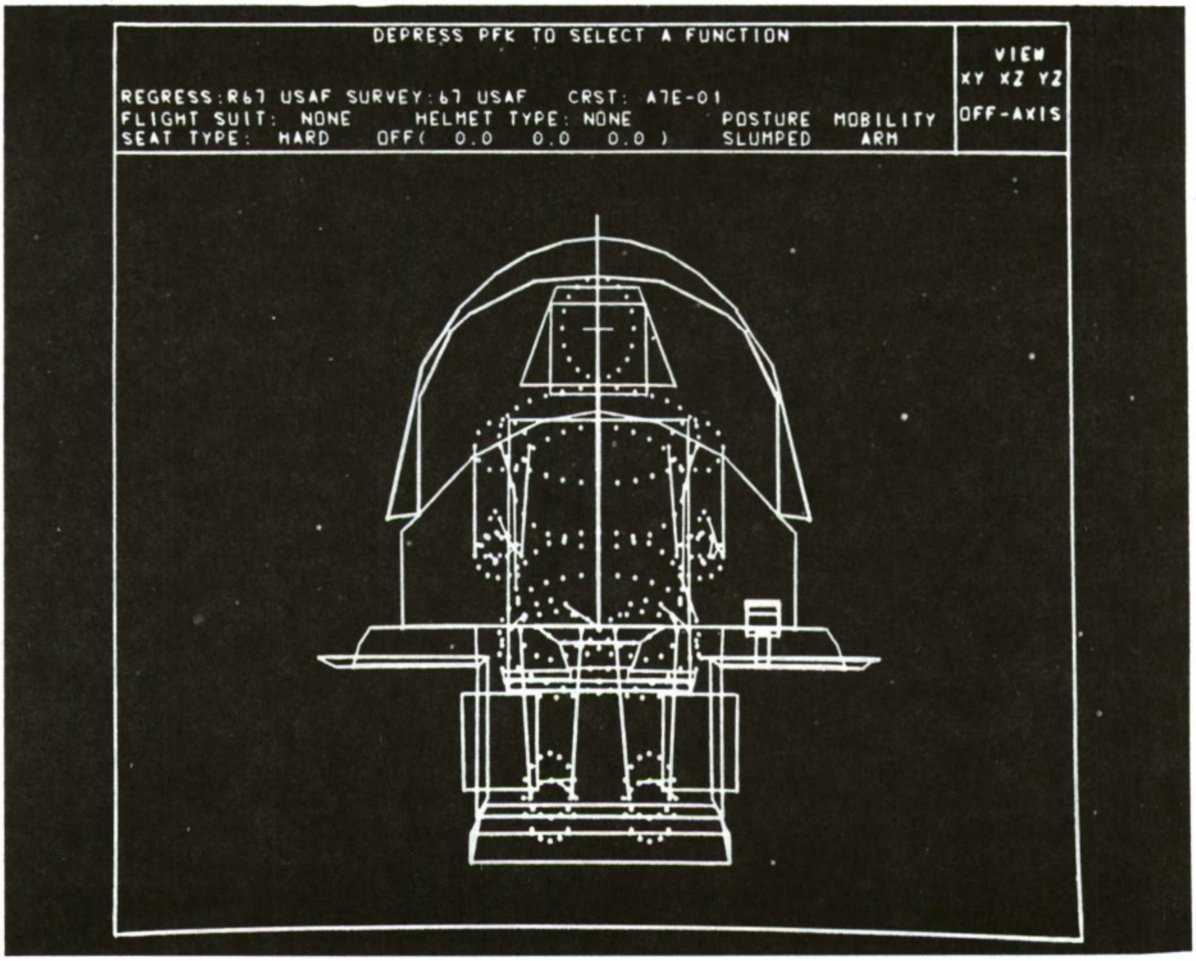

Figure 13. Front View (Y-Z Plane) of the Man-Model and a Crew Station.

2.2.2 IDENTIFY OBJECT Function (PFK1)

The IDENTIFY OBJECT function displays identifying information in the Information Area of the CRT for any object (man-model skeletal link or crew station panel) chosen by the user. After depressing PFK1, the message "LIGHT-PEN OBJECT" appears in the Prompting Area of the CRT. The user must then light-pen the object to be identified.

The following three pieces of information for the light-penned object are displayed in the Information Area:

1) The internal reference number of the object,
2) Reference coordinates for that object, and
3) The 8-character name of the object.

The internal reference number is a unique integer, assigned by the program, which identifies each link or panel. The reference coordinates for the object are the X, Y, and Z coordinates of the distal end point for man-model link or the X, Y, and Z coordinates of the first vertex (as defined in Crew Station Data Base - see Section 5) for selected panel. The 8-character name of the object is either the link name (see Table 3) or the name of the panel as it exists in the Crew Station Data Base. Figure 14 shows the result of an IDENTIFY OBJECT function performed on the HUD (heads up display) in the A7E-01 crew station. The information displayed in the Information Area of the CRT,

62 22.09 3.74 32.26 HUDSCRN

indicates that its internal reference number is 62, the coordinates of its first vertex are X = 22.09, Y = 3.74, and Z = 32.26, and its name is HUDSCRN.

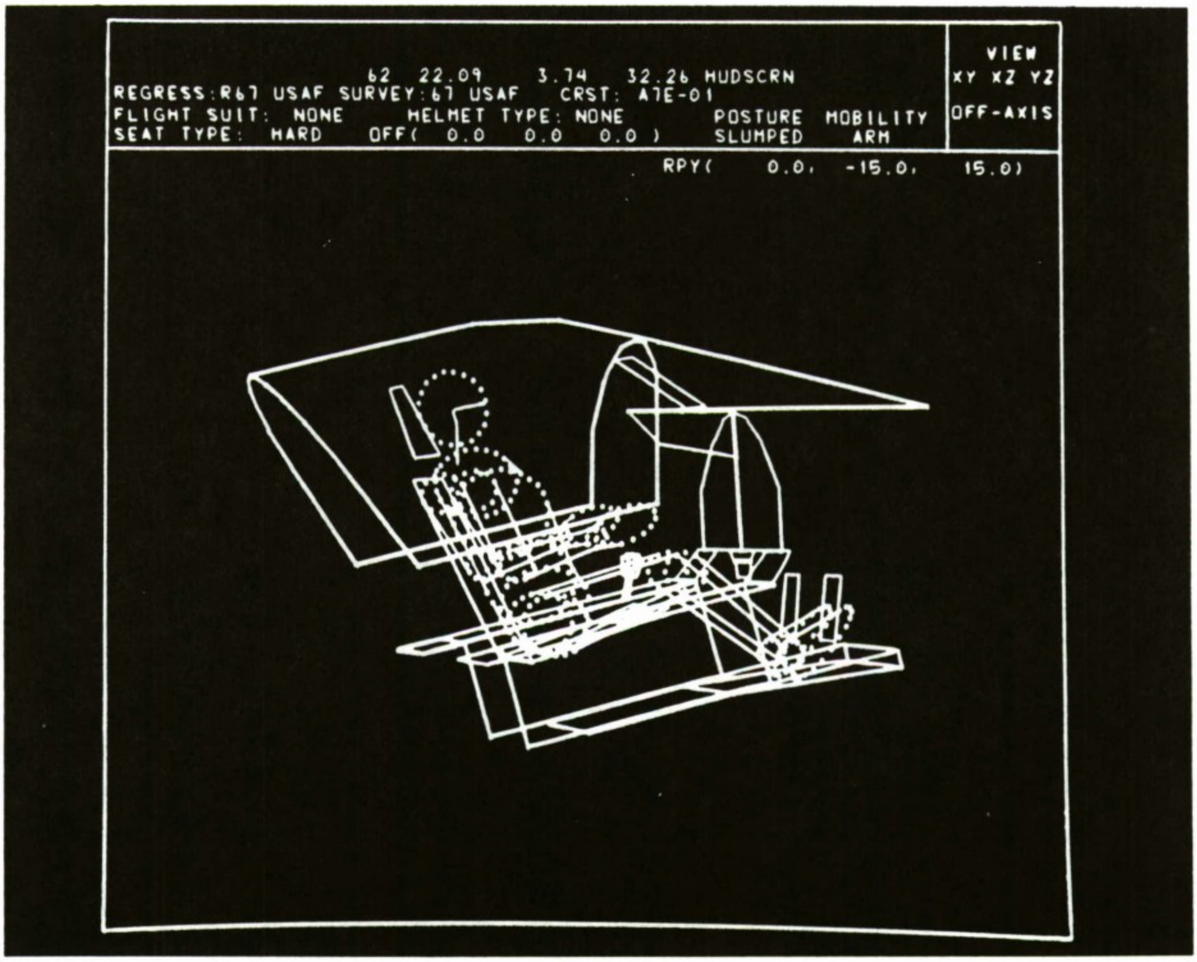

Figure 14. The IDENTIFY OBJECT Function Performed on the HUDSCRN (Heads Up Display) of the A7E-01 Crew Station.

The message "CBM010I IDENTIFIED _link/panel name_" along with distal end coordinates of the identified link or coordinates of all vertices of the identified panel are printed on the message unit.

2.2.3 OMIT OBJECT Function (PFK2)

The OMIT OBJECT function temporarily removes a crew station panel or a man-model segment from the display. This function is used to "de-clutter" the display.

On depressing PFK2, the message "LIGHT-PEN OBJECT" appears in the Prompting Area of the CRT. The user must then light-pen the object to be omitted. The program then displays the internal reference number of the object, the X, Y, and Z coordinates of the distal-end point of the selected man-model link or the X, Y, and Z coordinates of the first vertex of the selected panel, and the 8-character name of the object in the Information Area of the CRT. The internal reference number of the object is a unique integer, assigned by the program, which identifies each link and panel. It is the same number that the IDENTIFY OBJECT function displays and must be supplied by the user if the INCLUDE OBJECT function (see Paragraph 2.2.4) is used to redisplay the omitted object. The user may write down these numbers for future reference. Any omitted object can be redisplayed by supplying its internal reference number while performing INCLUDE OBJECT function. Also, all omitted objects are redisplayed whenever the man-model and crew station are regenerated (e.g. during a CHANGE VIEW function or a function which involves use of the cross symbol). Figure 15 shows the message created by OMIT OBJECT function when heads up display screen (HUDSCRN) of A7E-01 crew station is light-penned and Figure 16 shows the display with the HUDSCRN omitted. Note that the message generated by OMIT OBJECT function on CRT display is identical to that of IDENTIFY OBJECT function.

The message "CBM011I OMITTED link/panel name" and distal end coordinates of the omitted link or coordinates of all vertices of the omitted panel are printed on the message unit.

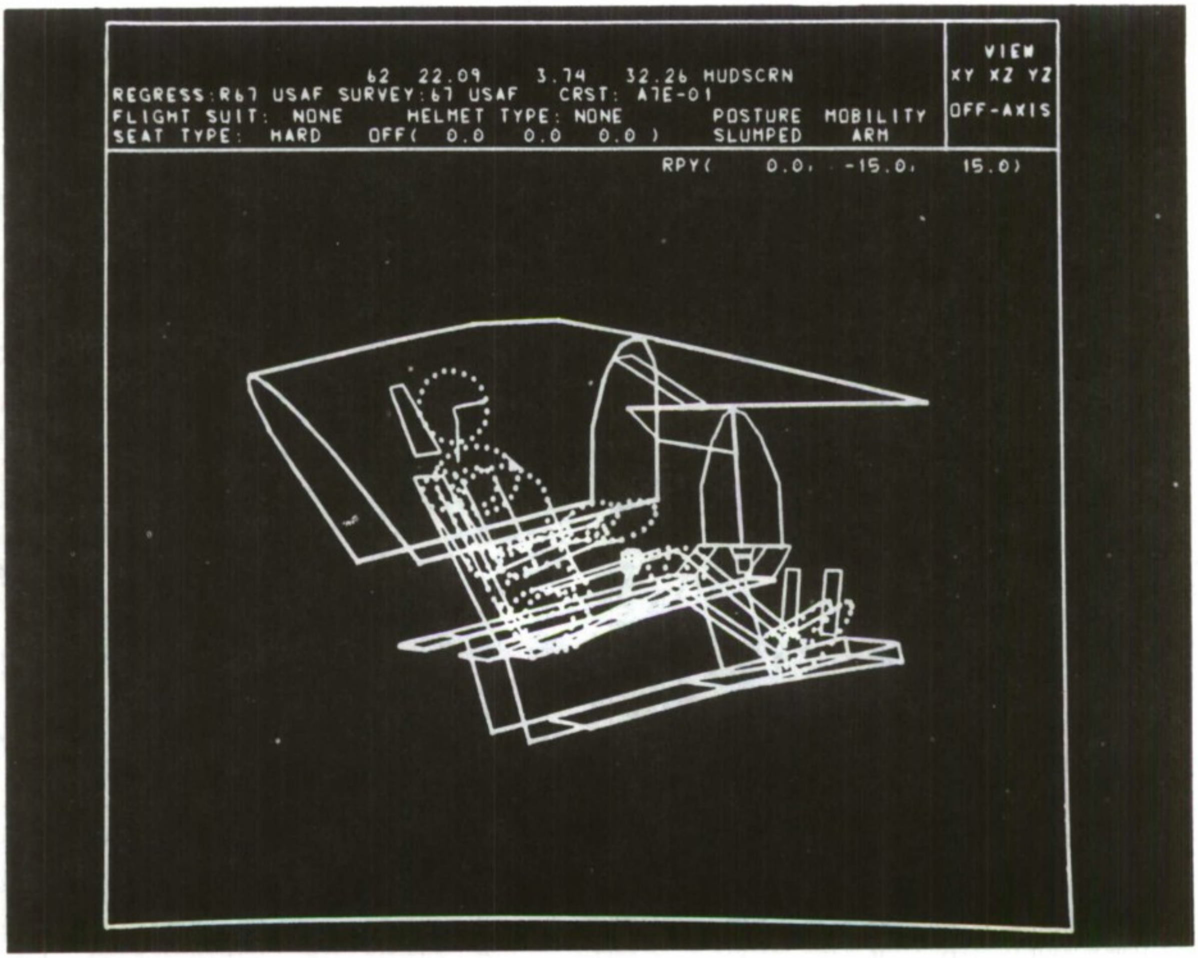

Figure 15. The OMIT OBJECT Function Performed on the HUDSCRN (Heads Up Display) of the A7E-01 Crew Station (Name of Light Penned Object is Displayed).

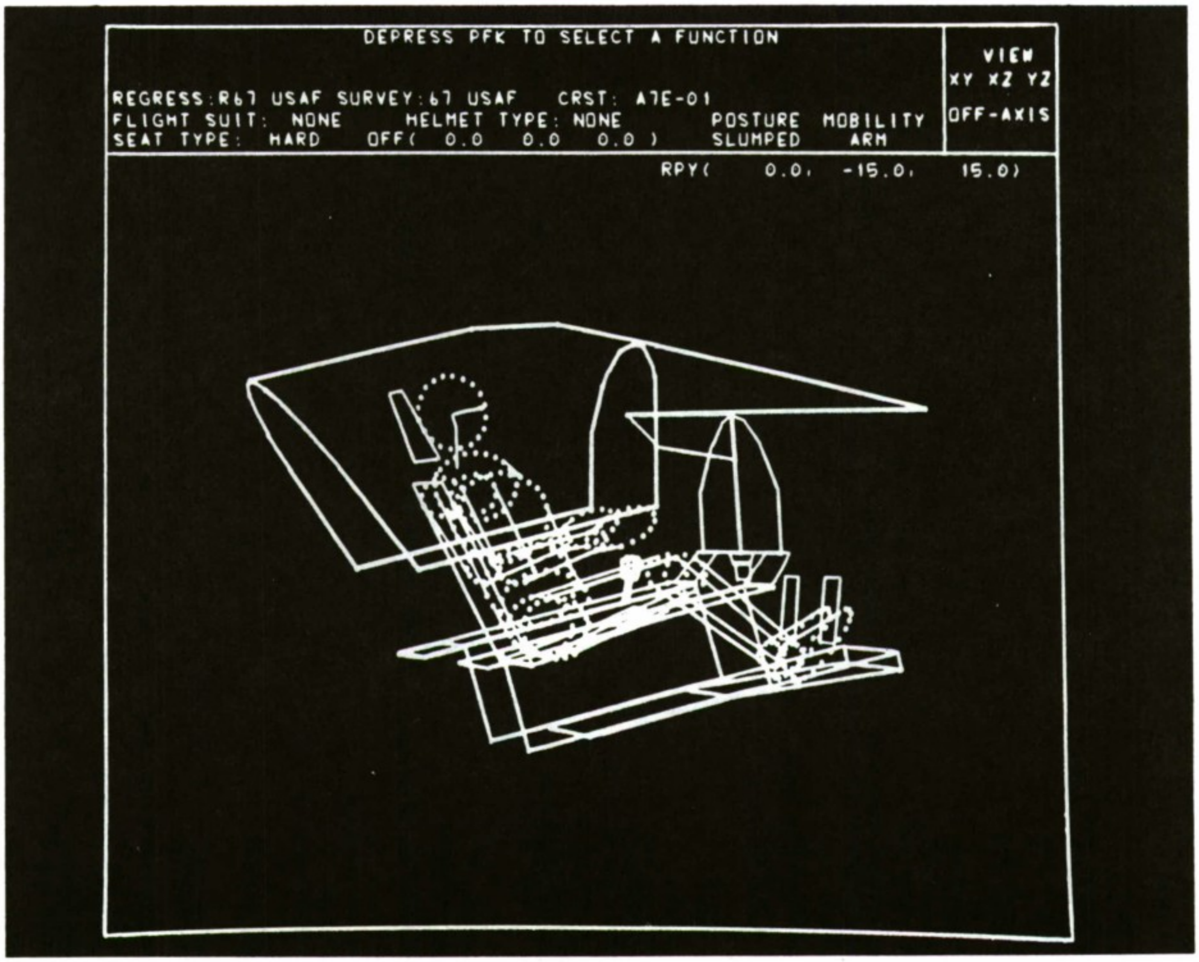

Figure 16. The OMIT OBJECT Function Performed on the HUDSCRN (Heads Up Display) of the A7E-01 Crew Station.

2.2.4 INCLUDE OBJECT Function (PFK3)

The INCLUDE OBJECT function redisplays an object that was removed from display screen by OMIT OBJECT function. After depressing PFK3, the message "ENTER OBJECT NUMBER" appears in the Prompting Area of the CRT. The number is entered through ANKB followed by ALT-CODE/5 sequence. The only valid entries for this function are internal reference numbers of man-model skeletal links or crew station panels which have previously been deleted by OMIT OBJECT function. The program will keep prompting for a valid internal key number until the user supplies one or enters the ALT-CODE/5 sequence to ignore the function and return to the main program. There are no other messages associated with this function. Depressing PFK3 and entering key number 62 (HUDSCRN reference number) for the INCLUDE OBJECT function with Figure 16 would cause the heads up display screen to reappear in its original position in the crew station. The man-model and crew station display will once again look like that of Figure 15.

2.2.5 RETRIEVE ANTHROPOMETRY Function (PFK4)

This function is the first step in defining the size of the man-model. The user is first prompted to light-pen the name of a "regression member" from the Anthropometric Data Base. (A detailed explanation of regression and survey members is given in Section 4.) Regression membernames are displayed in the column headed "REGRESSION MEMBER", as shown in Figure 17. To choose the 1967 Survey of the USAF Flying Personnel, the user must light-pen R67 USAF; and to choose the 1970 Survey of U.S. Army Aviators the user must light-pen R70 ARMY*. Once a membername is light-penned, the message "MEMBER membername ACCEPTED" is displayed in the information area of the screen.

After the regression data are retrieved from the Data Base, the user must light-pen a Survey member name displayed on the CRT which corresponds to the selected regression displayed in the column headed "SURVEY MEMBER", as shown in Figure 18. (For each regression member only one survey member is supplied in this version.) While the message "MEMBER membername ACCEPTED" is displayed in the Information Area, the means, standard deviations, and percentiles for the anthropometric dimensions are retrieved from the Data Base.

The message "DEPRESS PFK 12 OR 13" then appears in the Prompting Area of the CRT. Here the user selects the anthropometric surface dimensions or internal link lengths vital to the generation of the man-model. The sequence of steps associated with these function keys is described in Paragraphs 2.2.12 and 2.2.13.

*NOTE: Other sets of survey data will be available in future updates of COMBIMAN or the user may create new members using the COMBIMAN Anthropometric Data Base Maintenance program (CBMAM).

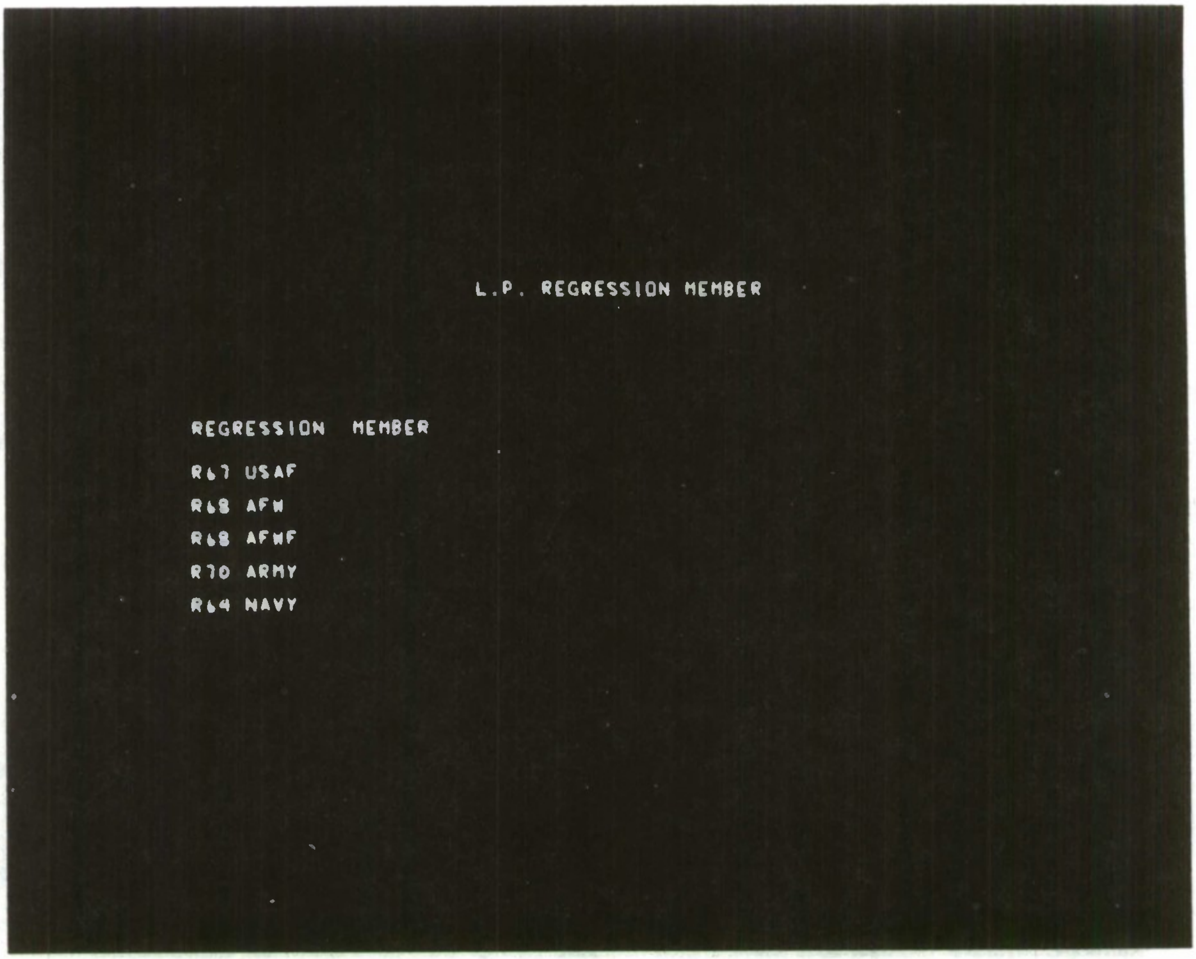

Figure 17. Table of Available Regression Member Names - One Member Must Be Selected by Light Penning.

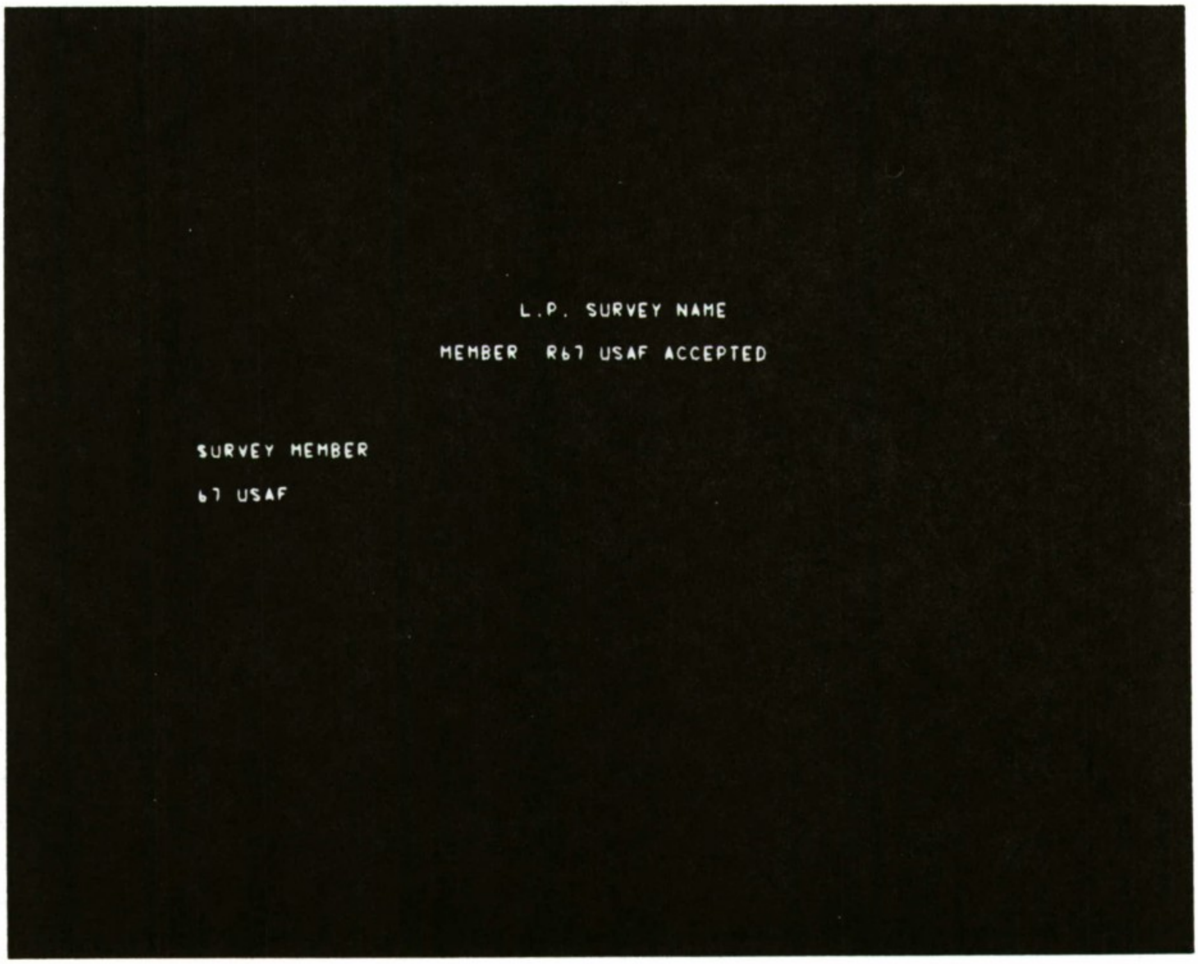

Figure 18. Table of Survey Member Name (for Regression Member R67 USAF) One Member Must Be Selected by Light Penning.

While the computations using the anthropometric data are in progress, the message "HUMAN ASSEMBLY" is displayed in the Information Area of the CRT. After this, the information is assembled for display and the message "CREATING DISPLAY" is displayed in the Information Area and the new man-model (and crew station if one was previously cued) appears on the screen.

2.2.6 RETRIEVE CREW STATION Function (PFK5)

The RETRIEVE CREW STATION function allows the user to retrieve a crew station from the Crew Station Data Base. After PFK5 is depressed, the user is prompted to light-pen a crew station. The crew station membernames are shown in Figure 19. The crew stations without seats are listed in the first column, and the seats are listed in the second column. The third column contains "*ERASE*" and "*NONE*". If a crew station name is light-penned without erasing the previous crew station, both crew stations are superimposed in the display. If "*NONE*" is light-penned, the RETRIEVE CREW STATION function is cancelled.

In order to erase all existing crew stations from the display area, depress PFK5 and light-pen "*ERASE*" and "*NONE*" in that order. When intentionally superimposing two or more crew stations, if the total number of panels exceeds 250, an overflow condition exists, and the message "TOO MANY PANELS/VERTICES * RETRY" appears in the Prompting Area of the CRT. The program then redisplays the crew station membernames as shown in Figure 20. The user may light-pen "*NONE*" to cancel the last entry and relieve the overflow condition.

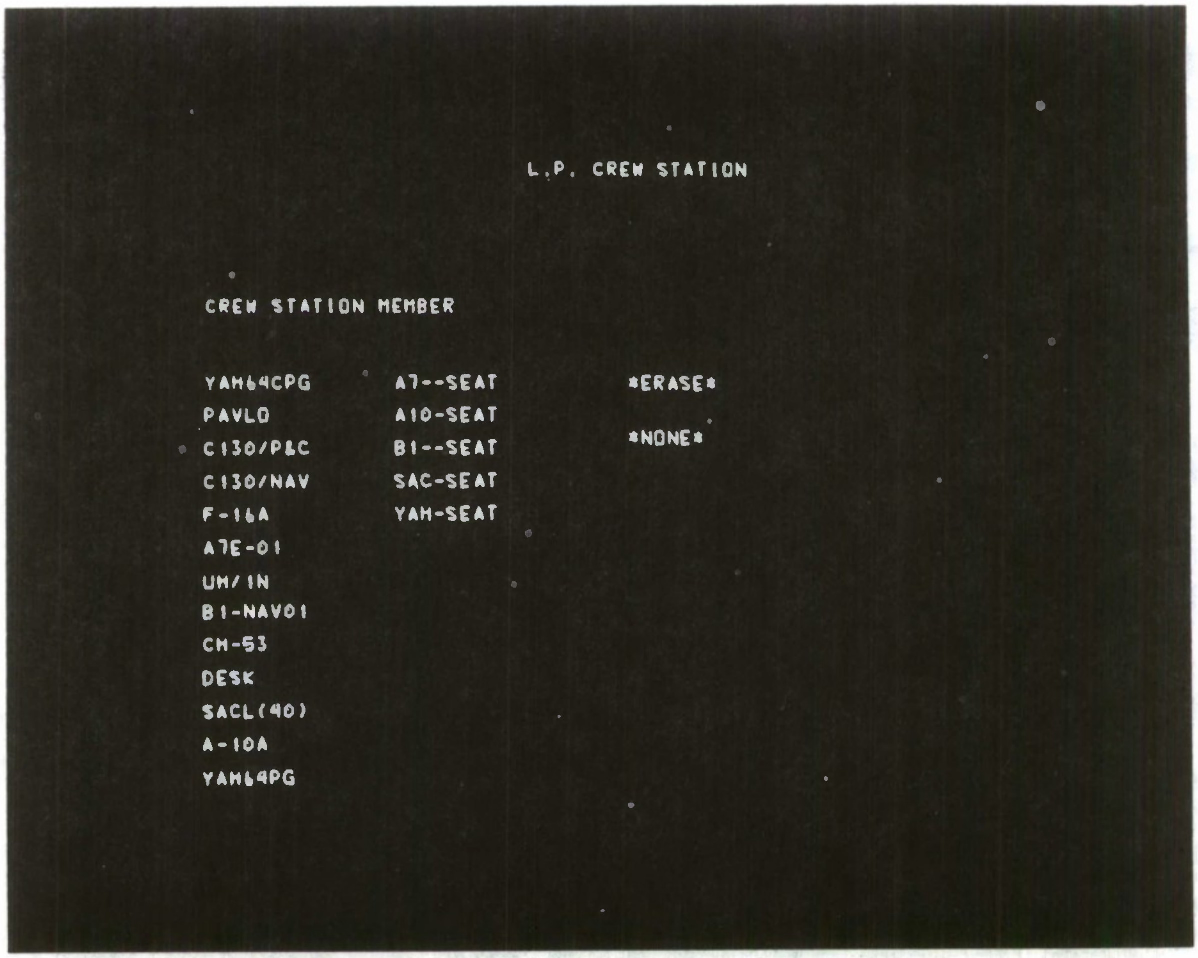

Figure 19. Table of Available Crew Station Membernames. Only A7E-01 is included in the Crew Station Data Base released with the COMBIMAN system. The user must add other crew stations.

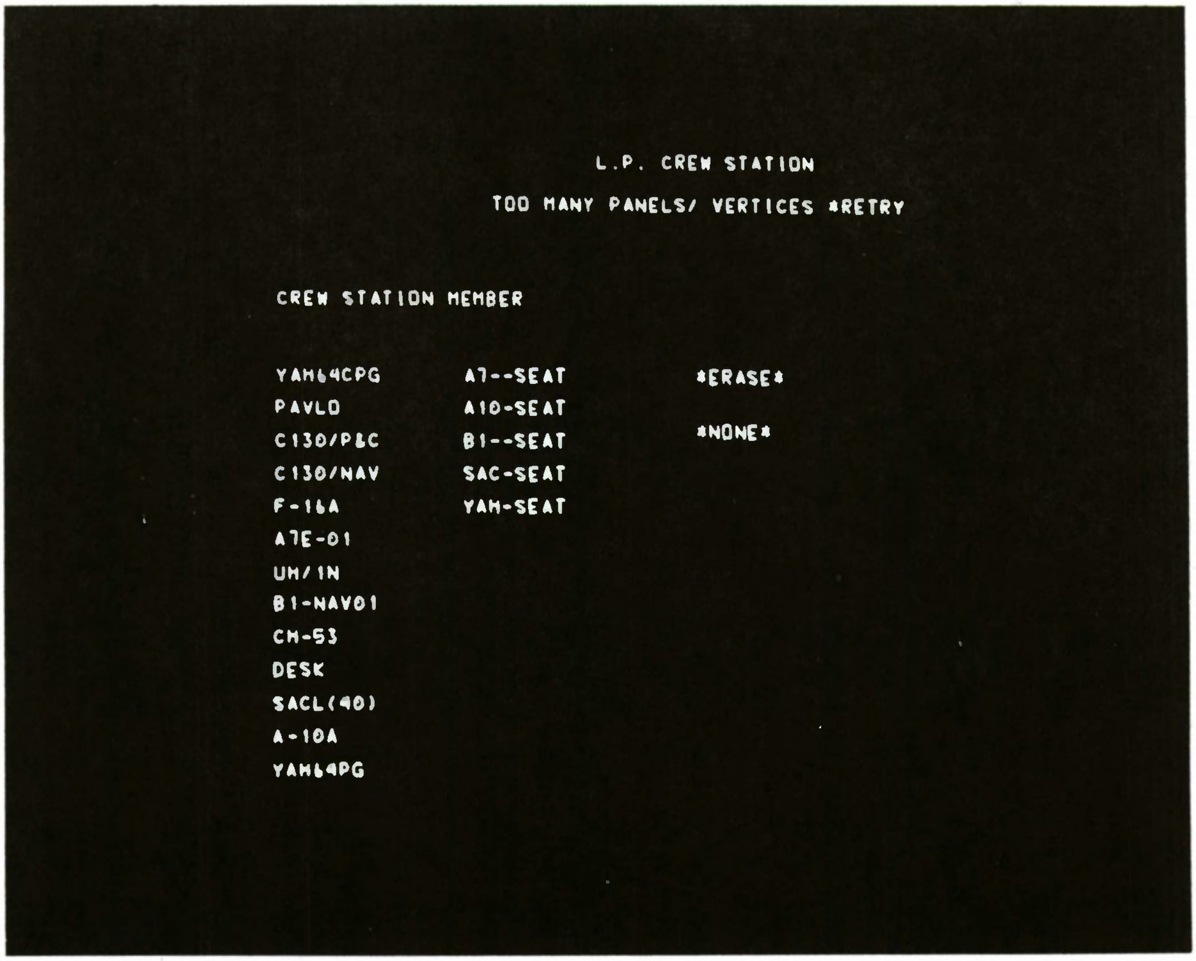

Figure 20. Table of Available Crew Station Member Name Displayed When the Total Number of Panels Exceeds 250.

2.2.7 VISIBILITY PLOT Function (PFK6)

The VISIBILITY PLOT function plots a map of visual azimuth and elevation line-of-sight angles to crew station components in the Visibility Data Base, as defined in MIL-STD-850, Rectilinear Plot. However, the plot of visual angles reflects the current orientation of the man-model within the crew station and the way the crew members would see the crew station from their viewpoint. After depressing PFK6 the message "ENTER EYE LOCATION (LINK NUMBER)" appears in the Prompting Area of the CRT. The user must select, as illustrated in Figure 21, the reference eye point to be used for the plot by entering "8" for Mid-Eye, "9" for Right Eye, or "10" for Left Eye using the ANKB and following the ALT-CODE/5 sequence. Now the available visibility members are displayed in a column under the heading "VISIBILITY MEMBER" as shown in Figure 22. The user then light pens the desired visibility member and the message "PLOTTING" is displayed in the Information Area of the CRT and the plot is generated on the GOULD plotter. The routine which performs this plotting uses the coordinates which define the vector from the mid-head position to mid-eye position (link 8) to calculate the angular orientation of the head from the horizontal and vertical directions. If the man-model is facing forward and looking straight ahead, the orientation of his head would be 0 degree from horizontal and 0 degree from vertical.

Figure 23 shows a sample visibility plot of a canopy clearline for a single seat aircraft. For this example, we chose the man-model to be 50th percentile weight and sitting height from the 1967 USAF Survey, seated erect, and looking straight ahead.

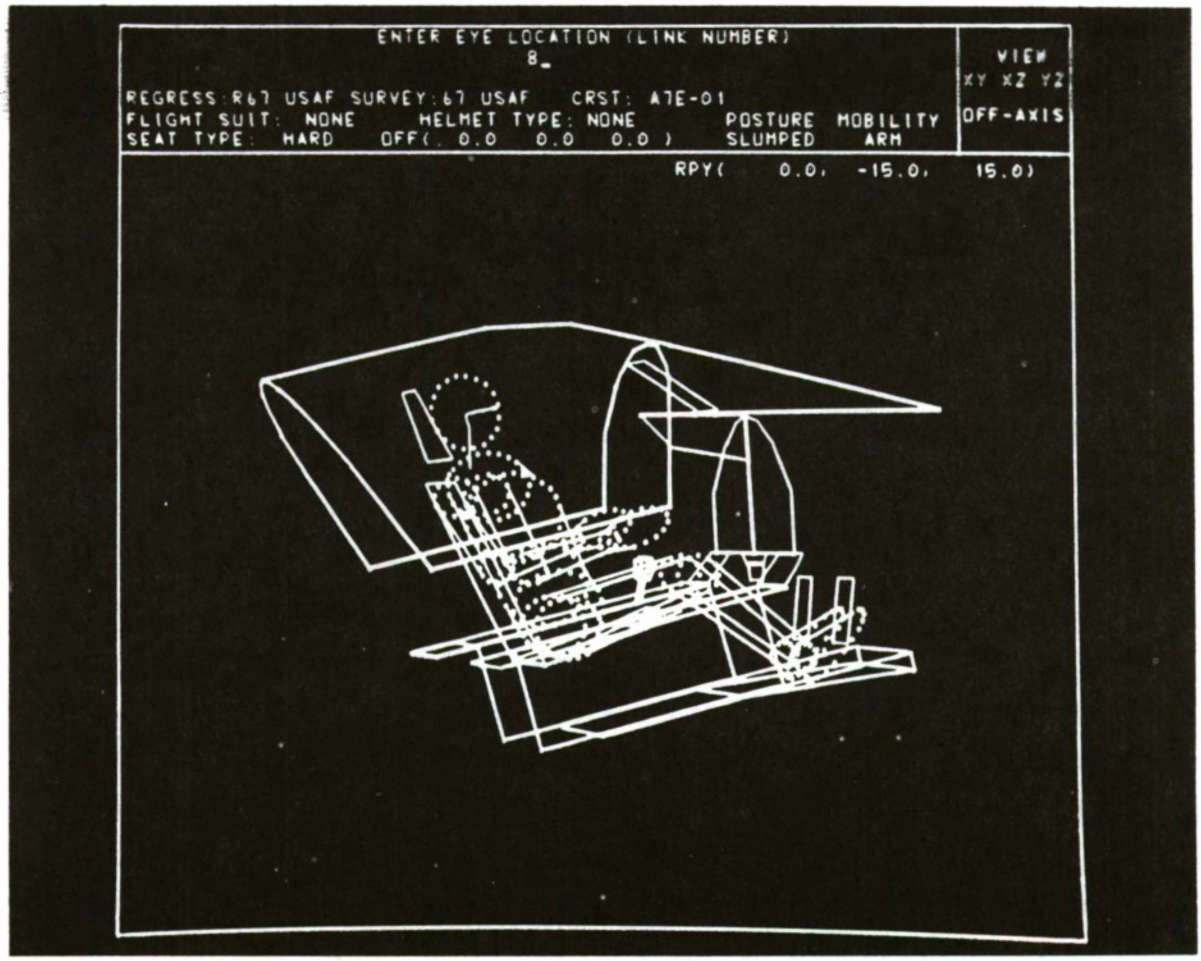

Figure 21. VISIBILITY PLOT Function. Enter Eye Location Link Number.

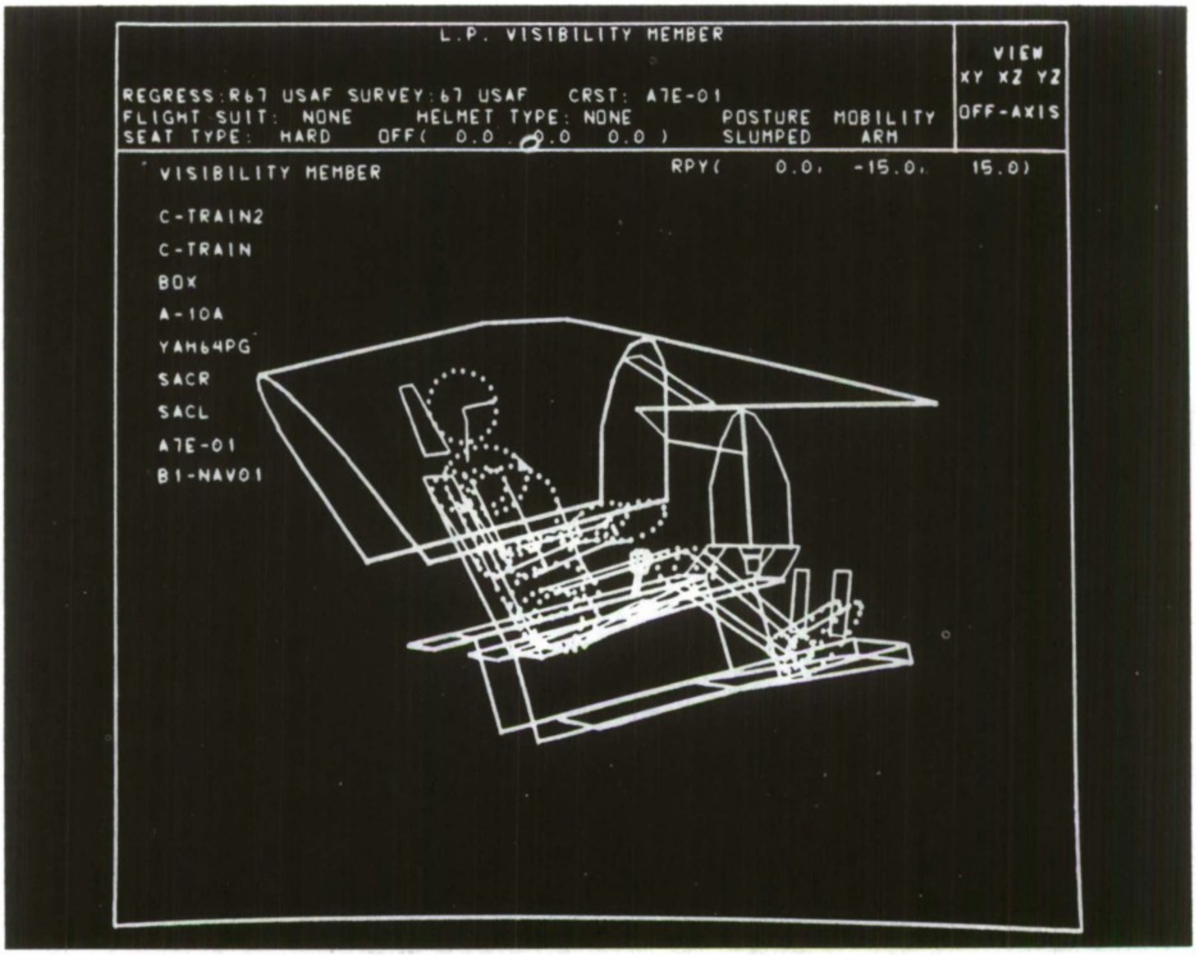

Figure 22. VISIBILITY PLOT Function. Select Visibility Member.

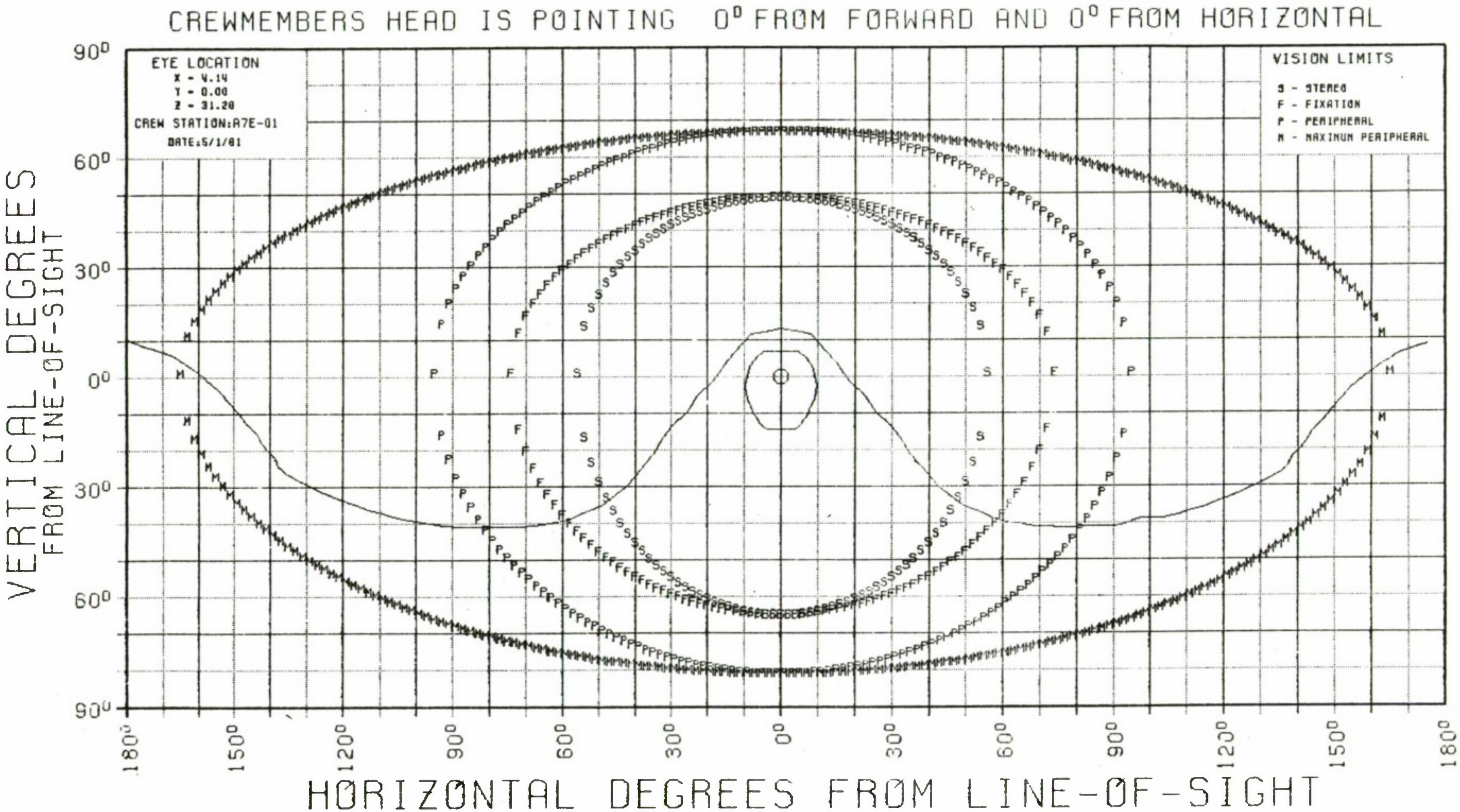

Figure 23. Visibility Plot.

The four ellipses superimposed on the plot define the limits of various visual fields. The innermost field, defined with letter S, is the field of stereovision, which is the field visible to both eyes simultaneously. The field defined with letter F, is the field of fixation, the region the eyes can see directly without turning the head. The field defined with letter P, is the field of peripheral vision with the eyes caged with respect to the head. The outermost field, defined with letter M, is the maximum peripheral vision limits for extreme eye deviations. The symbol "O" is the aim point of the head (and eyes if the eyes are caged forward with respect to the head). The vision limits are generated with respect to the angle of sight from the Mid-Eye point (end point of link 8).

In addition to generating a hard copy plot, if state switch 20 is set "ON" (see Table 4) the routine also calculates and prints a listing of the three dimensional coordinate of the objects plotted in five degree azimuth increments from -180 degrees from horizontal line of sight to +180 degrees for each panel and/or contour in the visibility member. This listing is a handy reference to the crew station drawings. The coordinates are given in the original user-supplied system of coordinates rather than the Neutral Seat Reference Point (NSRP) system of coordinates used elsewhere (see Paragraph 5.3.2.1). The listing also gives the coordinates of the eye location of the man-model. Figure 24 shows a part of the coordinate data for the plot in Figure 23.

VISIBILITY MEMBER NAME: A7E-01

EYE LOCATION IN SRP SYSTEM (4.14,   0.0 , 31.28)

LINE-OF-SIGHT IN DEGREES   (0,   0)

VISIBILITY PLOT DATA FOR CONTOUR: WINDSCREEN, FRONT TOP

LINE-OF-SIGHT ANGLES		ORIGINAL COORDINATES		
HORIZ.	VERT.	A	R	U
9	-7	227.630	-5.840	125.350
7	-9	223.790	-5.510	123.240
7	-11	220.980	-5.460	121.570
6	-12	218.930	-5.190	120.590
5	-13	215.790	-4.870	118.760
5	-14	213.140	-4.270	117.350
4	-14	211.090	-3.620	116.160
3	-14	209.140	-2.810	115.840
0	-14	209.140	0.0	115.840
-3	-14	209.140	2.810	115.840
-4	-14	211.090	3.620	116.160
-5	-14	213.140	4.270	117.350
-5	-13	215.790	4.860	118.760
-6	-12	218.930	5.190	120.590
-7	-11	220.980	5.460	121.570
-7	-9	223.790	5.510	123.240
-9	-7	227.630	5.840	125.350
-9	-6	230.000	5.780	126.650
-9	-4	232.120	5.680	127.840
-10	-2	234.440	5.410	129.030
-9	0	237.310	4.700	130.590
-9	3	239.410	4.050	131.730
-7	5	241.090	2.920	132.860
-5	7	242.120	2.000	133.410
0	7	242.120	0.0	133.410
5	7	242.120	-2.000	133.410
7	5	241.090	-2.920	132.860
9	3	239.410	-4.050	131.730
9	0	237.310	-4.700	130.590
10	-2	234.440	-5.410	129.010
9	-4	232.120	-5.680	127.840
9	-6	230.000	-5.780	126.650

Figure 24. Canopy Outline Coordinates in Aircraft System.

2.2.8 OFF-LINE PLOT COMBIMAN Function (PFK7)

The OFF-LINE PLOT COMBIMAN function saves the coordinate data of the man-model and crew station currently displayed for later use to generate an off-line plot. The prompting and informational messages for this function and the necessary replies are identical to those for the ON-LINE PLOT COMBIMAN function described in Paragraph 2.2.9.

After depressing the OFF-LINE PLOT function key (PFK7) the message "PERSPECTIVE PLOT? ENTER Y/N" is displayed in the Prompting Area shown in see Figure 25. Here the user has the option to select a perspective or nonperspective plot. A perspective plot shows the man-model and crew station with infinite perspective (as displayed on the CRT). Nonperspective plot does not show any perspective. The user must type "Y" or "YES" for a perspective plot, or "N" or "NO" for a nonperspective plot using the ANKB, and must perform the ALT-CODE/5 sequence.

The program then displays the message "ENTER PLOT SCALE FACTOR" in the Prompting Area of the CRT. For a perspective plot, a scale factor of 1.0 produces a 10 x 10 inch plot identical to the size of the Display Area on the CRT. For a nonperspective plot, the scale factor is applied to full-scale data. The user must consider the size restrictions of the available plotter when specifying the scale factor. For example, a 1.0 scale perspective plot is about the same size as a 0.10 scale nonperspective plot.

To enter the scale factor, the decimal value is typed using the ANKB as shown in Figure 26 and is followed by the ALT-CODE/5 sequence. When a valid scale factor (greater than 0.0) is entered, the message "PLOTTING" appears in the

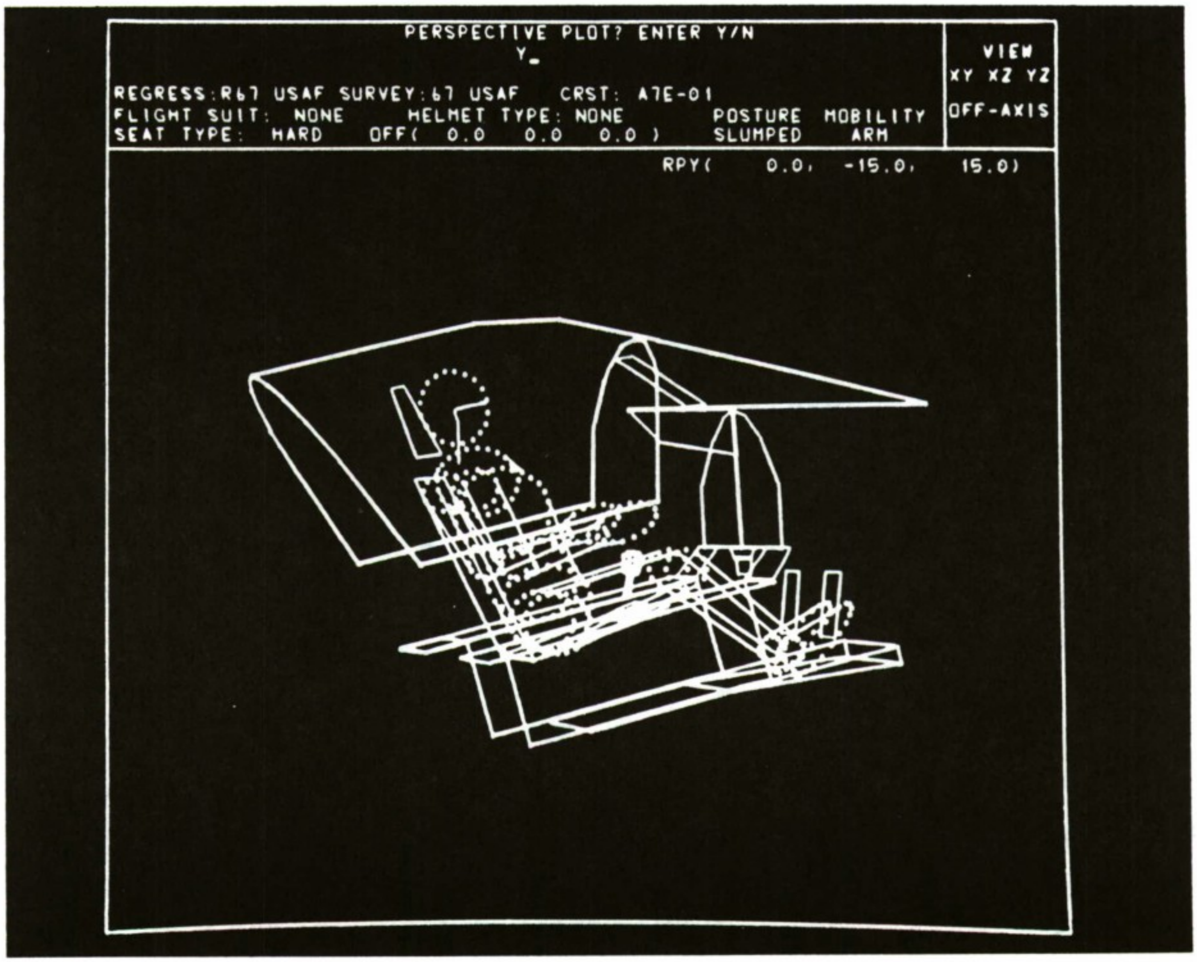

Figure 25. The Message and a Response for the COMBIMAN PLOT Function.

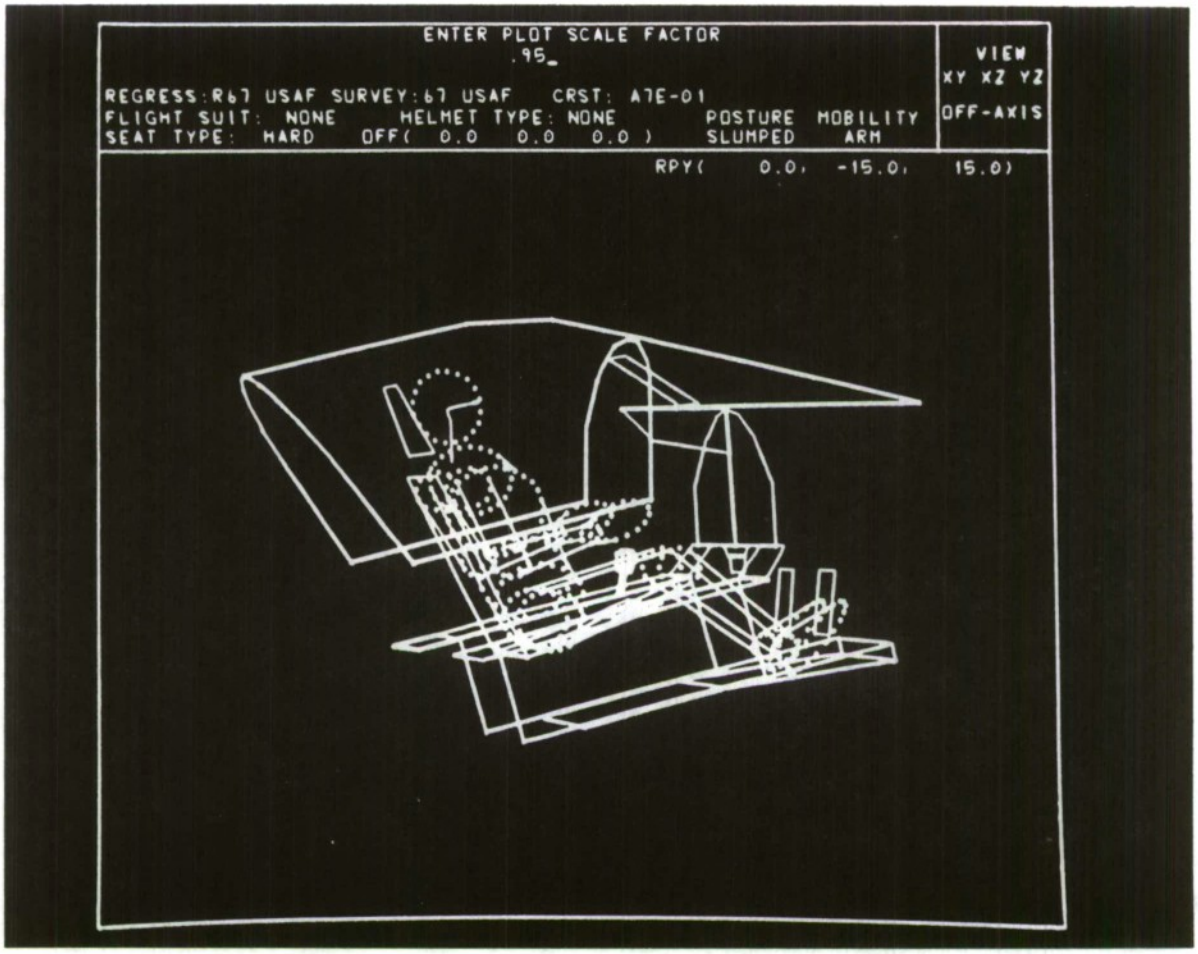

Figure 26. ON-LINE PLOT Function. Enter Plot Scale Factor.

Information Area of the CRT as shown in Figure 27 and the data are written to a disk file for later use as described in Section 3.

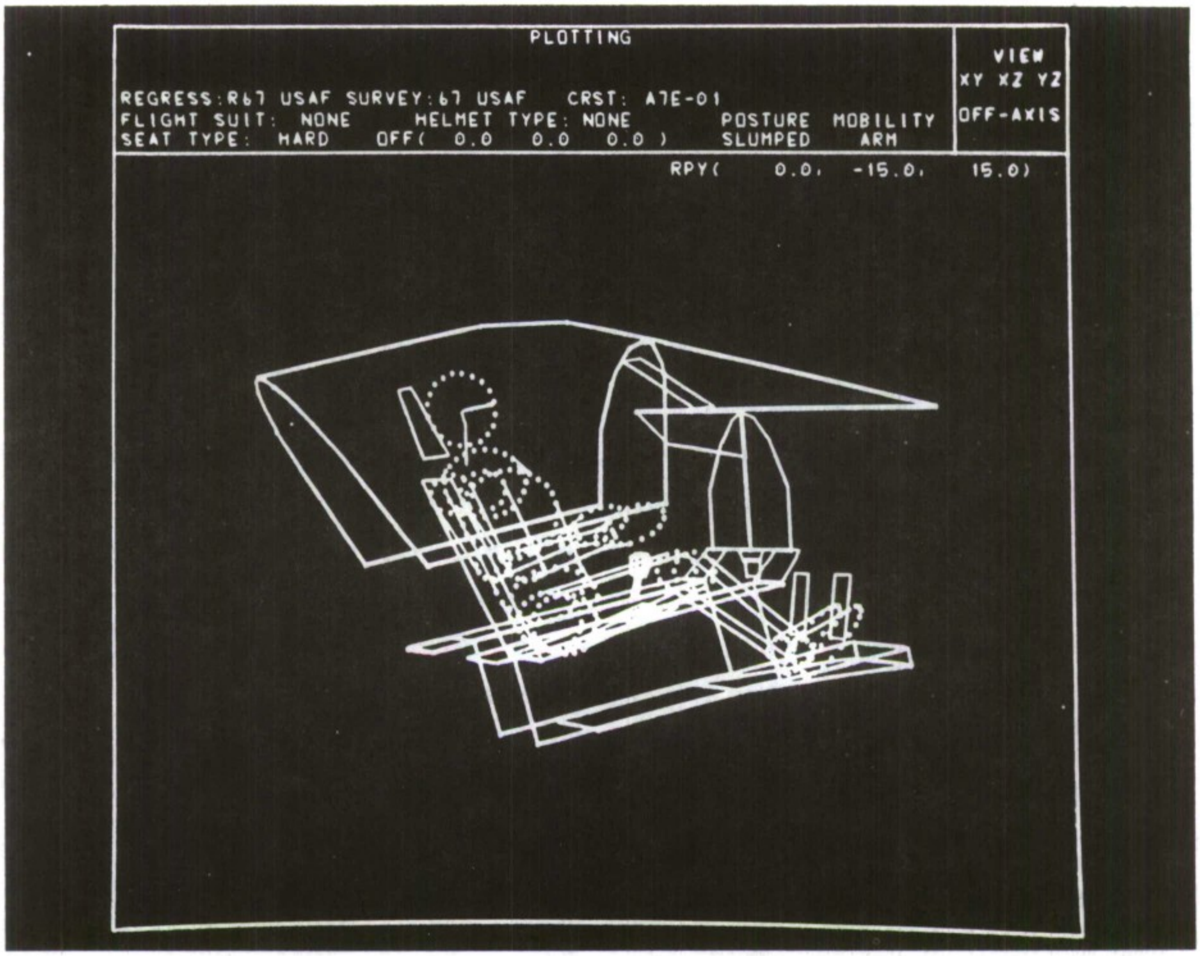

Figure 27. ON-LINE PLOT Function. Message "PLOTTING" Displayed When Plotting is Done on the GOULD Plotter.

2.2.9 ON-LINE PLOT COMBIMAN Function (PFK8)

The ON-LINE PLOT COMBIMAN function generates on-line plots of the man-model and crew station configuration currently shown in the Display Area of the screen. After depressing the ON-LINE PLOT function key (PFK8), the user has the option of selecting a perspective or a nonperspective plot (see Paragraph 2.2.8). The program displays the message "PERSPECTIVE PLOT? ENTER Y/N" in the Prompting Area of the CRT. The user must respond "Y" or "YES" for a perspective plot, or "N" or "NO" for a nonperspective plot, from the ANKB (see Figure 25).

The program then displays the message "ENTER PLOT SCALE FACTOR" in the Prompting Area of the CRT (see Paragraph 2.2.8). To enter the scale factor, the decimal value is typed using the ANKB and is followed by the ALT-CODE/5 sequence (see Figure 26). When a valid scale factor (greater than 0.0) is entered the program displays the message "PLOTTING" in the Information Area of the CRT (see Figure 27), and a hard copy plot is generated. Note that the scale factor is applied to the display image size for perspective plots, and to the full scale coordinates for nonperspective plots. A sample on-line perspective plot is shown in Figure 28.

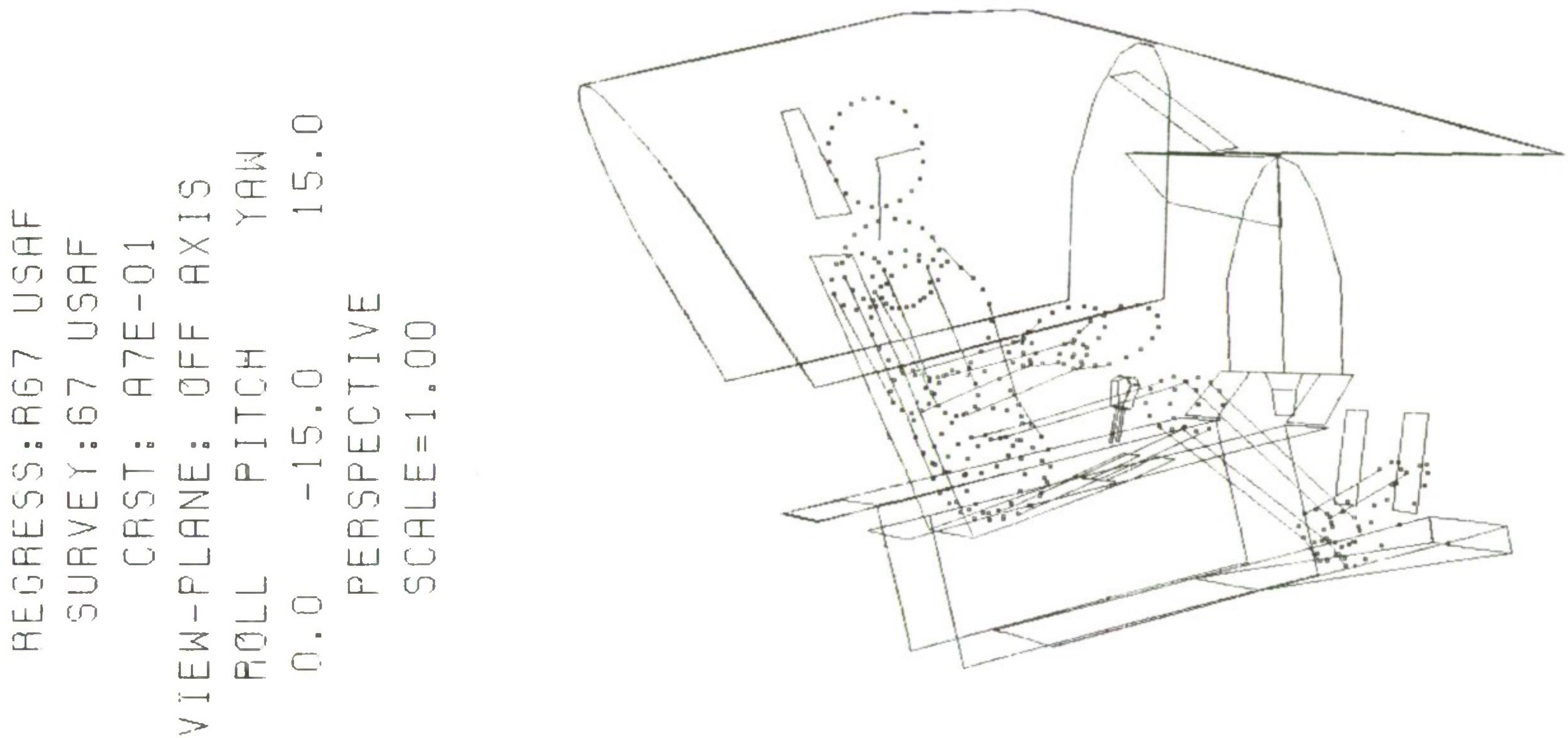

Figure 28. ON-LINE PLOT Function. A Sample Perspective On-Line Plot.

2.2.10 <u>PRINT DATA Function (PFK9)</u>

The PRINT DATA function prints man-model and crew station data. The man-model data consist of, for each link, the X, Y, and Z coordinates of the distal end of each link, the transformation angles for each link, and the enfleshment semi-axes lengths.

Data for the displayed crew station panels consist of the name, type, and X, Y, and Z coordinates of all the vertices. The coordinates of each control on the displayed crew station together with its name and name of the panel it is located on, if any, are also printed. An example of the output generated by the PRINT DATA function is shown in Figure 29.

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COMBIMAN LINK DATA

SURVEY DATA IS 67 USAF

NO.	NAME	DISTAL END X	DISTAL END Y	DISTAL END Z	JOINT ANGLES PHI	JOINT ANGLES THETA	JOINT ANGLES PSI	SEMI AXIS LENGTHS ALPHA	SEMI AXIS LENGTHS BETA	SEMI AXIS LENGTHS GAMMA
0	SRP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	SRP-MHIP	4.64	0.0	3.41	0.0	53.70	0.0	4.58	7.41	4.58
2	STOMACH	2.82	0.0	8.26	0.0	-74.20	0.0	4.37	6.07	4.37
3	CHEST	0.26	0.0	17.37	0.0	4.80	0.0	4.81	6.43	4.81
4	LWR NECK	-0.48	0.0	24.82	0.0	10.00	0.0	3.61	8.01	3.61
5	UPR NECK	0.80	0.0	29.87	0.0	20.00	0.0	0.0	0.0	0.0
6	MID HEAD	0.80	0.0	31.28	0.0	-14.30	0.0	3.88	3.04	4.47
7	MH-MEYE	4.14	0.0	31.28	0.0	90.00	0.0	0.0	0.0	0.0
8	MEYE-REY	4.14	-1.25	31.28	-90.00	90.00	0.0	0.0	0.0	0.0
9	MEYE-LEY	4.14	1.25	31.28	90.00	90.00	0.0	0.0	0.0	0.0
10	LN-MIDSS	2.56	0.0	23.76	0.0	115.00	0.0	0.0	0.0	0.0
11	MSS-RSS	2.56	-1.00	23.76	-90.00	90.00	29.30	0.0	0.0	0.0
12	RSS-RSLD	-1.14	-8.01	21.44	22.00	31.90	0.0	0.0	0.0	0.0
13	RSLDR	-1.14	-8.01	21.44	0.0	-31.90	-112.00	2.31	2.30	2.07
14	RUPARM	0.76	-8.01	10.68	0.0	-90.00	-90.00	1.73	1.73	1.73
15	RLWARM	11.16	-8.01	12.51	0.0	90.00	0.0	1.10	1.10	1.10
16	RGRIPCTR	13.13	-8.01	12.86	0.0	0.0	0.0	2.01	0.54	3.76
17	RFRCH	15.78	-8.01	13.33	0.0	0.0	0.0	0.0	0.0	0.0
18	RFNGRTIP	18.57	-8.01	13.82	0.0	0.0	0.0	0.0	0.0	0.0
19	MSS-LSS	2.56	1.00	23.76	90.00	90.00	-29.30	0.0	0.0	0.0
20	LSS-LSLD	-1.14	8.01	21.44	-22.00	31.90	0.0	0.0	0.0	0.0
21	LSLDR	-1.14	8.01	21.44	0.0	-31.90	112.00	2.31	2.30	2.07
22	LUPARM	0.76	8.01	10.68	0.0	-90.00	90.00	1.73	1.73	1.73
23	LLWRARM	11.16	8.01	12.51	0.0	90.00	0.0	1.10	1.10	1.10
24	LGRIPCTR	13.13	8.01	12.86	0.0	0.0	0.0	2.01	0.54	3.76
25	LFRCH	15.78	8.01	13.33	0.0	0.0	0.0	0.0	0.0	0.0
26	LFNGRTIP	18.57	8.01	13.82	0.0	0.0	0.0	0.0	0.0	0.0
27	MHIP-RHP	4.64	-3.43	3.41	-90.00	90.00	53.70	3.24	3.24	4.10
28	RUPRLEG	21.53	-3.43	5.48	97.00	90.00	-90.00	2.16	2.16	2.16
29	RLWRLEG	31.25	-3.43	-7.42	0.0	60.00	0.0	1.40	1.40	1.40
30	RNK-RRCH	32.58	-3.43	-9.18	0.0	0.0	0.0	5.32	1.92	1.28
31	MHIP-LHP	4.64	3.43	3.41	90.00	90.00	-53.70	3.24	3.24	4.10
32	LUPRLEG	21.53	3.43	5.48	-97.00	90.00	90.00	2.16	2.16	2.16
33	LLWRLEG	31.25	3.43	-7.42	0.0	60.00	0.0	1.40	1.40	1.40
34	LNK-LRCH	32.58	3.43	-9.18	0.0	0.0	0.0	5.32	1.92	1.28

Figure 29. Output for COMBIMAN PRINT Function.

2.2.11 PERFORM REACH ANALYSIS Function (PFK11)

The PERFORM REACH ANALYSIS function causes the man-model to attempt an arm reach to a selected point in space.

First, the program prompts the user to light-pen REACH MOBILITY: ARM, LAP, or SHOULDER as shown in Figure 30. ARM mobility allows only arm movement while the shoulder and torso remain fixed. LAP mobility allows arm, shoulder, and torso movement. SHOULDER mobility allows arm and shoulder movement while the torso remains fixed. After the reach mobility has been selected the program prompts the user to light-pen the REACH TYPE (see Figure 31). There are two reach types, right arm (RARM) and left arm (LARM). After the reach type has been selected, the program prompts the user to light-pen the EXTENT OF REACH. There are three choices: grip center (GRIPCTR) which indicates a grasping motion such as for a control stick, functional (FUNCTRCH) which indicates a pinching motion such as for turning a knob, and finger tip (FNGRTP) which indicates a touching motion, such as for a push button (see Figure 32). Figure (1) shows the relative locations of these points on the hand. The shape of the hand on the man-model remains the same regardless of which grip type is selected. Once the extent of reach type has been selected, the program displays the man-model/crew station configuration in the X-Z plane (side view) in a nonperspective view (see Paragraph 2.2.8). The program then pompts the user to position the cross symbol ("+") at the point to be reached within the display area. The program uses a slewable "+" to locate and designate the 3-D coordinates of points of interest on the displayed image.

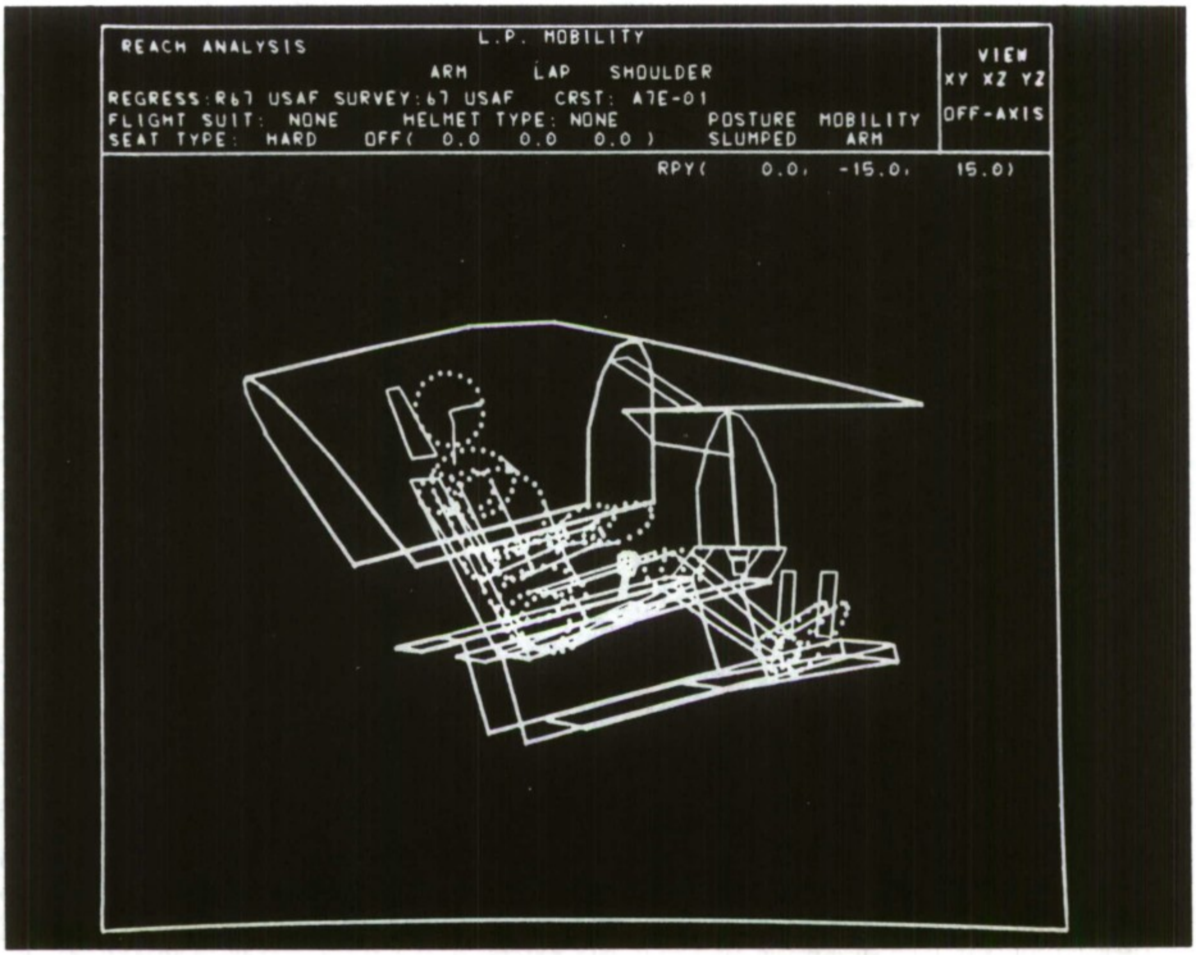

Figure 30. PERFORM REACH ANALYSIS Function.
First message "L.P. MOBILITY".

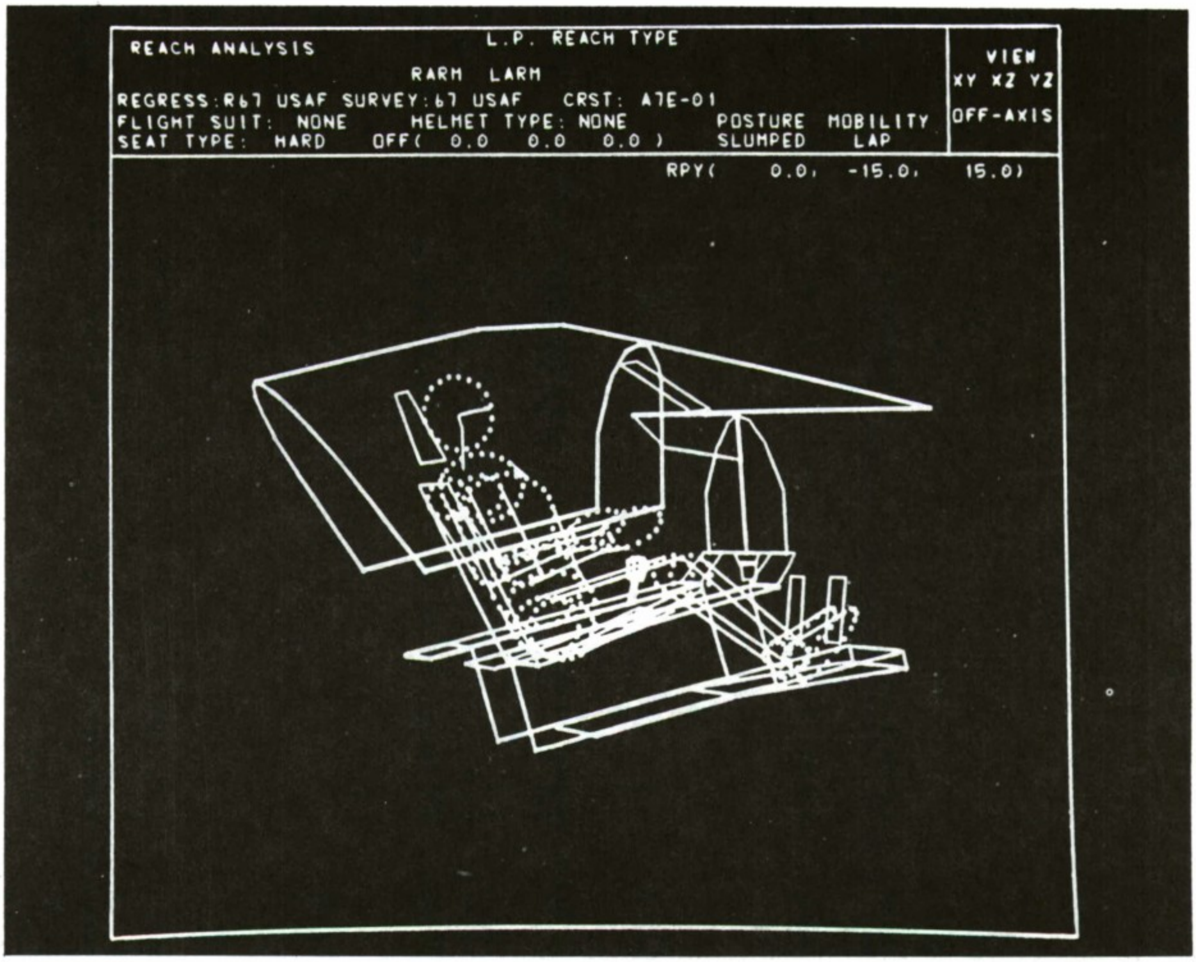

Figure 31. PERFORM REACH ANALYSIS Function Light Pen Reach Type.

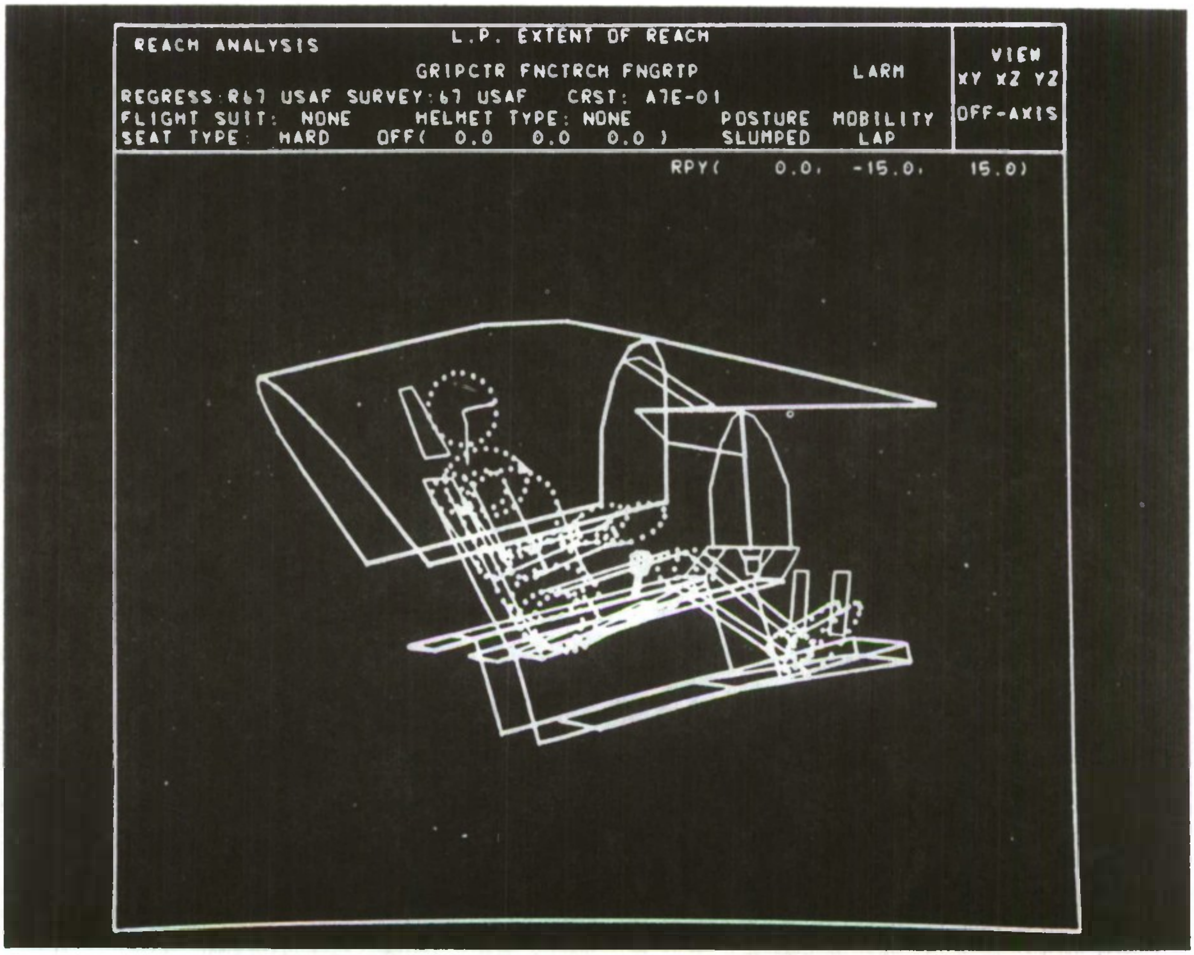

Figure 32. PERFORM REACH ANALYSIS Function Light Pen Extent of Reach.

2.2.11.1 Positioning the Cross Symbol "+"

Initially, the program displays a cross symbol ("+") at the seat reference point (SRP) as shown in Figure 33. The user must first position the "+" in the X-Z plane (side view) to define the X and Z coordinates, and then in the Y-Z plane (front view) to define the Y-coordinate of the reach point. Note that the Z-coordinate can be redefined while positioning the cross in the Y-Z plane. Figures 34 and 35 show the man-model in X-Z and Y-Z planes respectively with the "+" at a point to be reached on the instrument panel. The "+" is precisely positioned on a point using the Program Function Keyboard as described in the following paragraphs.

The PFKs are temporarily redefined as shown in Figure 36. The direction and magnitude of movement of "+" on the screen when these PFKs are depressed are indicated inside the circles representing the PFKs in the figure. By selecting the proper PFK, the "+" can be moved up, down, left, right, or combinations of these, at two different speeds. For example, depressing PFK7 causes the "+" to move up and right in one inch increments at a rate of approximately 25 steps per second.

Once in motion, the direction and/or magnitude of movement of the cross can be changed simply by depressing another directional PFK. The motion may be stopped by depressing the STOP/RECORD key (PFK12) once, or depressing the SINGLE STEP ON key (PFK26). After depressing the STOP key, motion can be continued by selecting any other key. As soon as the cross is near the desired point, depress the SINGLE STEP ON key (PFK26). This stops automatic motion of the cross, allows the cross to be moved in single steps of 0.1 or 1.0 inch each time a directional key is depressed. In this way, the cross

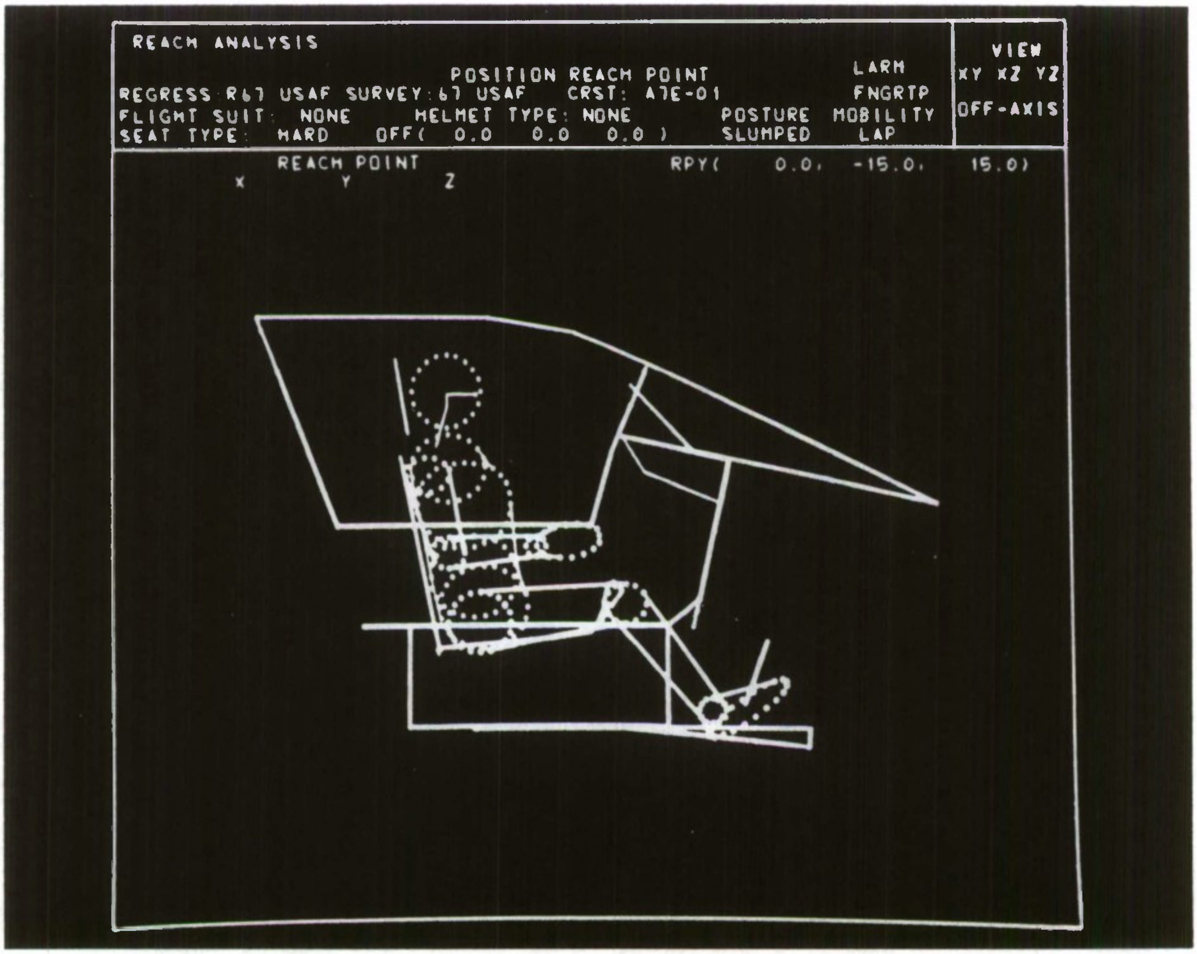

Figure 33. Positioning Cross Symbol "+" Initially the Cross Symbol is Displayed at the SRP.

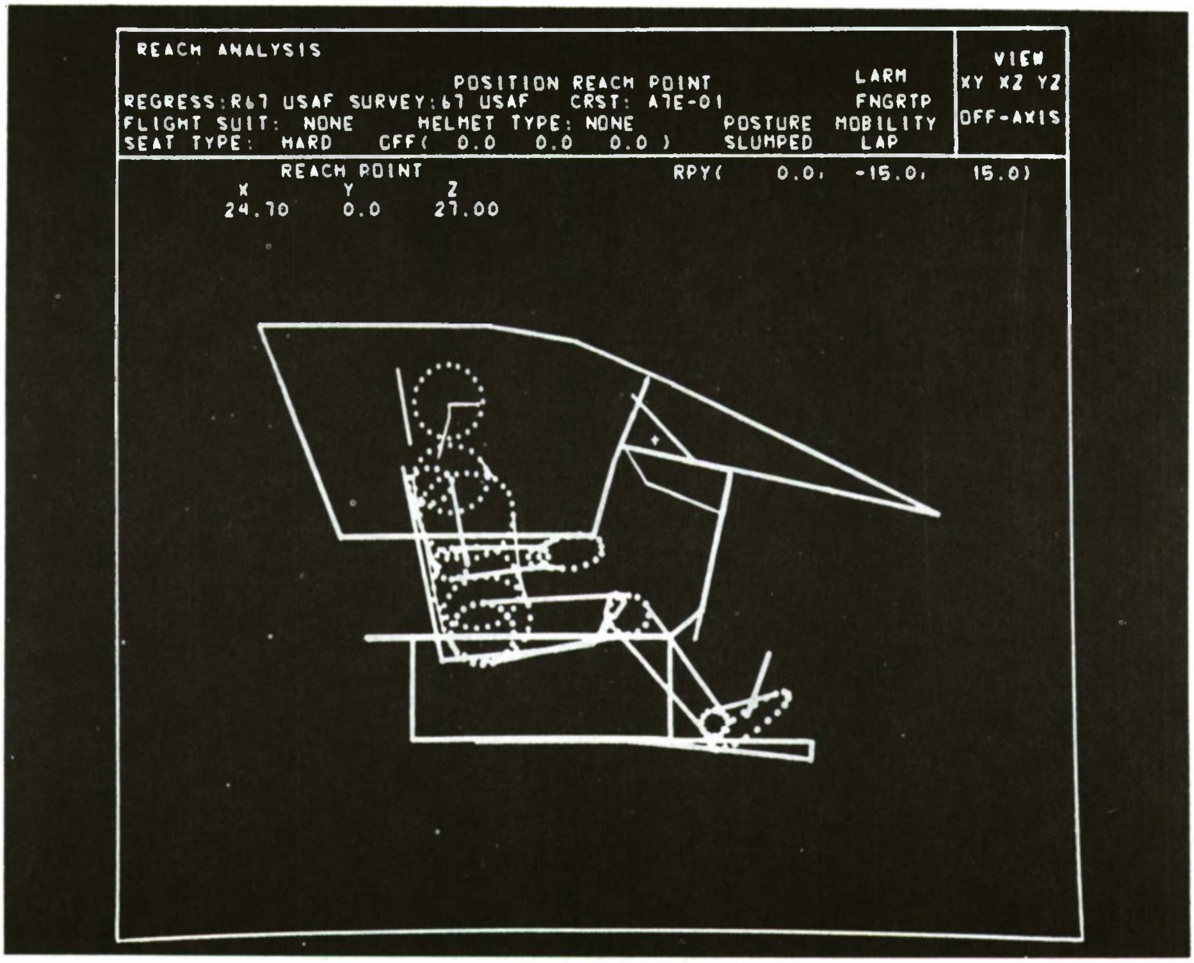

Figure 34. Side View (X-Z Plane) - the "+" Symbol Locates the Reach Point. The X and Z Coordinates are Defined in this View Note the Coordinates Displayed in the Upper-Left Hand Display Area.

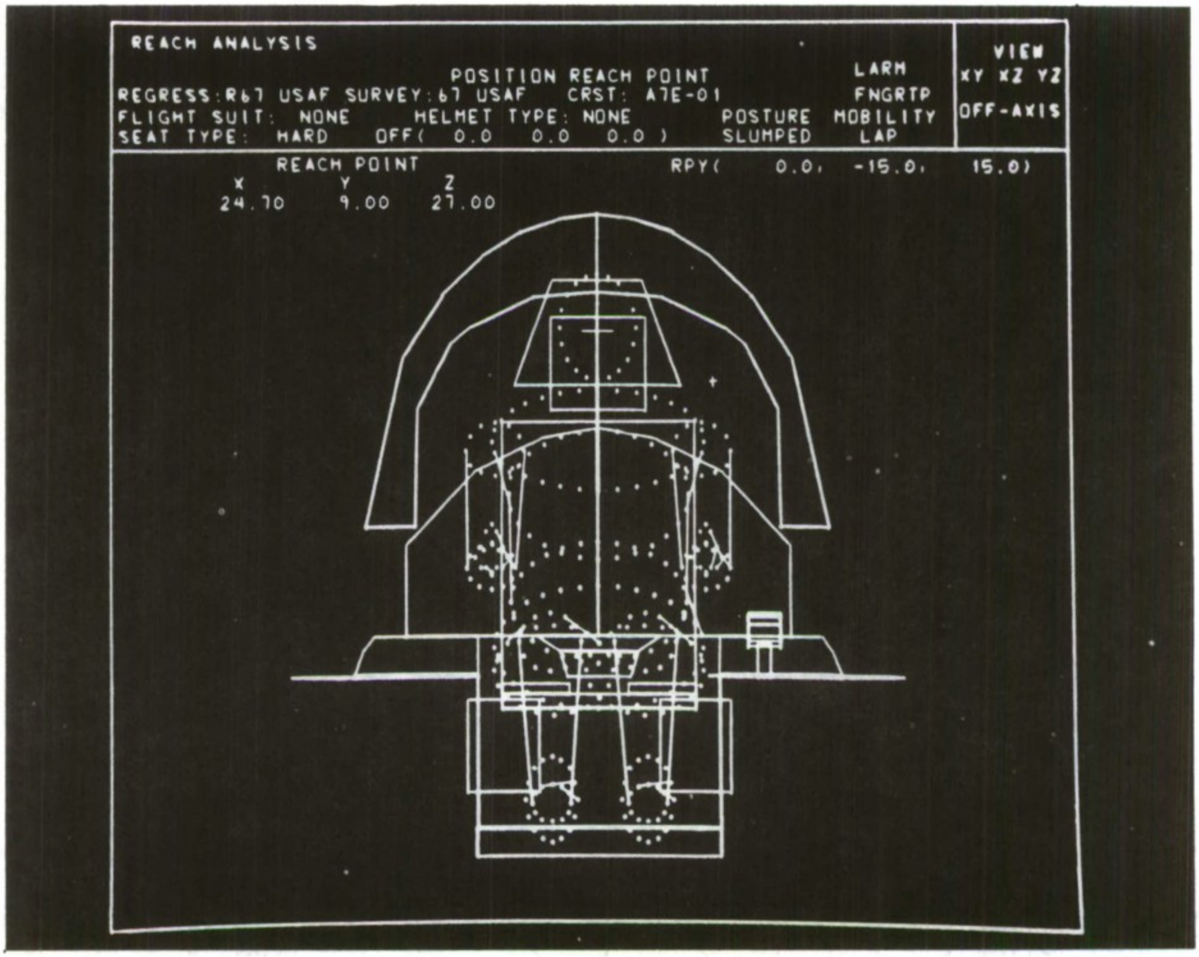

Figure 35. Front View (Y-Z Plane). The "Cross" Symbol is Used to Define the Y Coordinate. The Z Coordinate May Also be Redefined in this View.

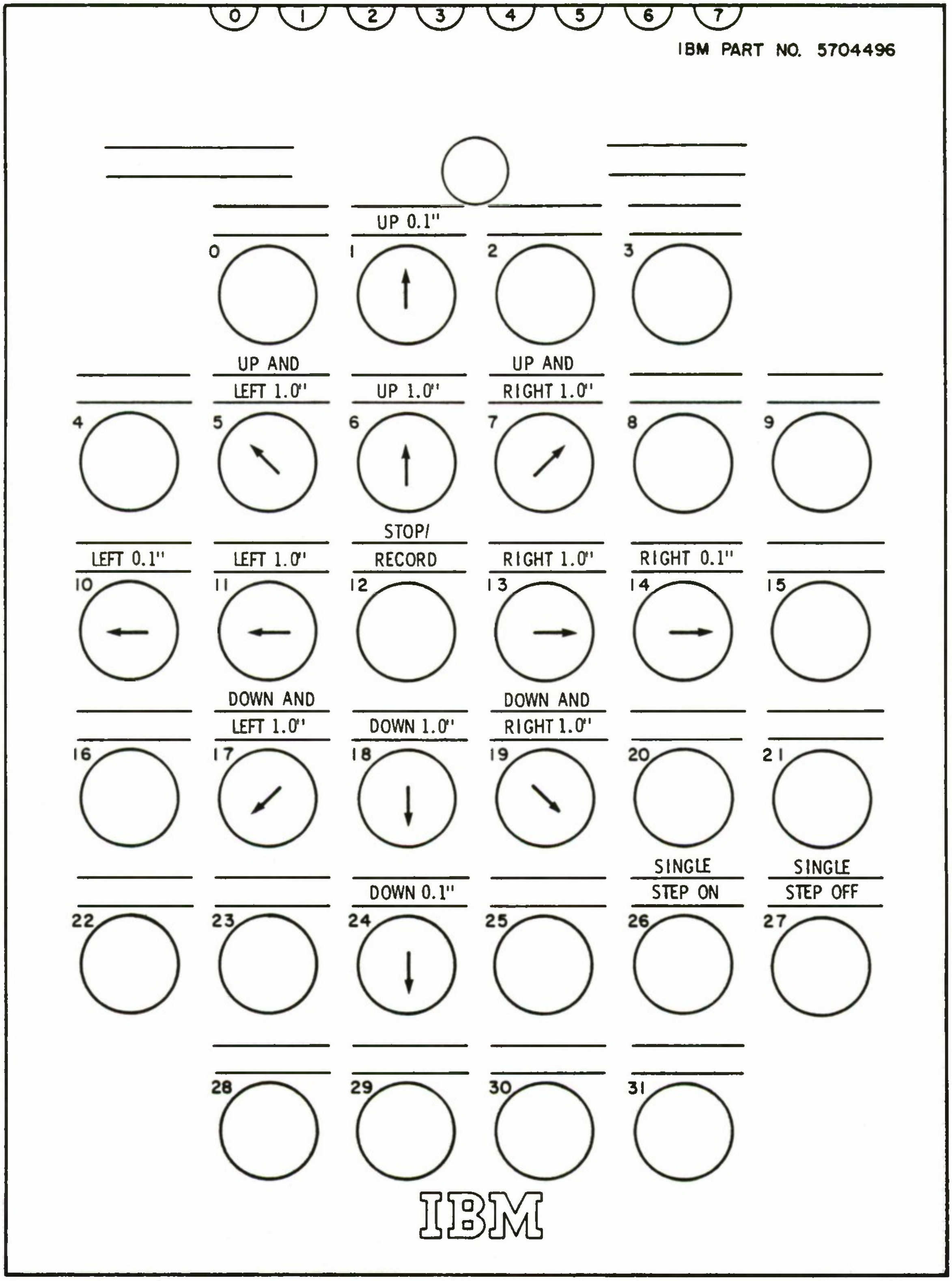

Figure 36. Redefined Program FUNCTION Keys for Positioning the "+" Symbol.

may be positioned precisely by (1) monitoring the position of the cross relative to the displayed image, or (2) monitoring the X, Y, Z Coordinate Readout (see Figure 34) which appears in the upper-left part of the Display Area when this function is in progress. This latter method is to be used when the coordinates of the point are known. Note that these coordinates are in the Seat Reference Point coordinate system. Also note that this is different from the NSRP (Neutral Seat Reference Point) coordinate system used to displace the seat in the SEAT ADJUST function.

To locate and enter a 3-D coordinate set proceed as follows:

- When the "+" is to be used to locate a point, the display automatically transitions to a side view (XZ plane).
- Move the cross to the desired location in the side view by the method described above.
- Depress the STOP/RECORD key (PFK12) twice in succession to enter the X coordiante.
- The display automatically transitions to a front view (YZ plane).
- Use the left or right direction keys to position the cross in the Y direction.

NOTE: If the cross is moved up or down, the Z coordinate is redefined.

- Depress the STOP/RECORD key (PFK12) twice in succession to enter the Y and Z coordinates.
- The display automatically transitions to the orientation in use at the time the PERFORM REACH function was activated.

Now the PFKs are reset to their original definition and the man-model begins to reach toward the specified point in three to six discrete steps. When the reach is successful, "REACH SUCCESSFUL" is displayed in the Information Area of the display as shown in Figure 37. If the man-model could not reach the point, the message "MISS DISTANCE" and the miss distance value in inches are displayed in the Information Area of the CRT display as shown in Figure 38.

2.2.11.2 Post Reach Processing

Following the reach, the user must light-pen the response "YES" or "NO" displayed below the prompting message "PRINT REACH DATA? L.P. YES OR NO" (see Figures 37 or 38). If the user's response is "YES", a summary of the reach analysis as shown in Figure 39 is printed out. There will be no printed output if the user light pens "NO".

The message "CONTINUE REACH? L.P. YES OR NO" is then displayed in the Prompting Area of the CRT screen. If the user wants to continue the reach analysis with the same arm or have a two arm reach, the light-pen response must be "YES". In this case the program restarts the reach routine and prompts the user to light-pen the reach type (see Paragraph 2.2.11). If the user desires a two arm reach, "LARM" must be light-penned if the first choice was "RARM" and vice versa. When a two arm reach is executed, the first reach determines the position of the shoulder and trunk. The reach by the other arm is an "ARM ONLY" type of reach, with no shoulder or trunk movement. If the user light-pens "NO" the program progresses to display the next message "RESET POSTURE? L. P. YES OR NO". If the user light-pens "YES" the program resets the man-model to the posture before the reach attempt. If the user light-pens "NO" the man-model remains in the reaching posture. At this point the reach routine returns control to the main program.

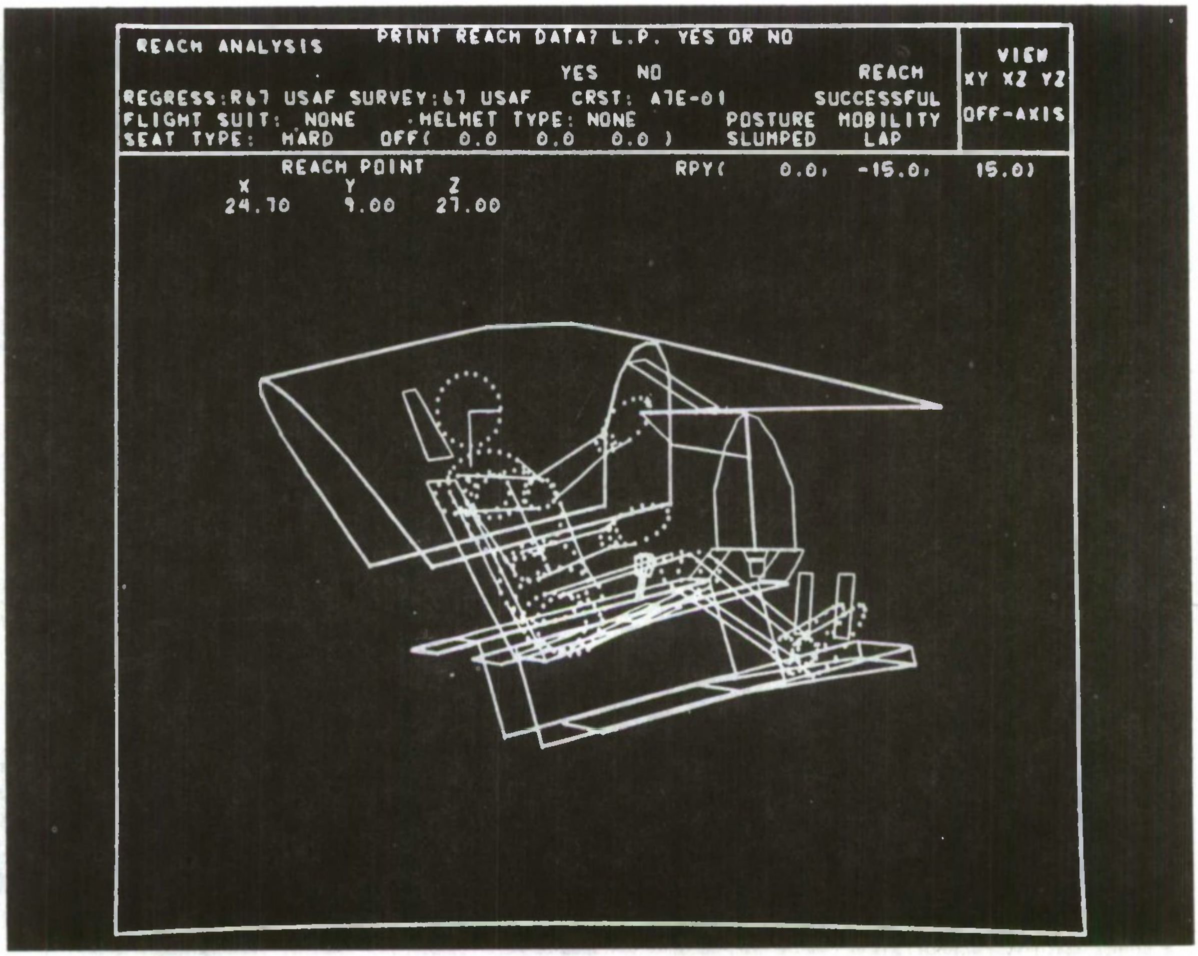

Figure 37. REACH SUCCESSFUL is Displayed after the Reach is Successfully Performed.

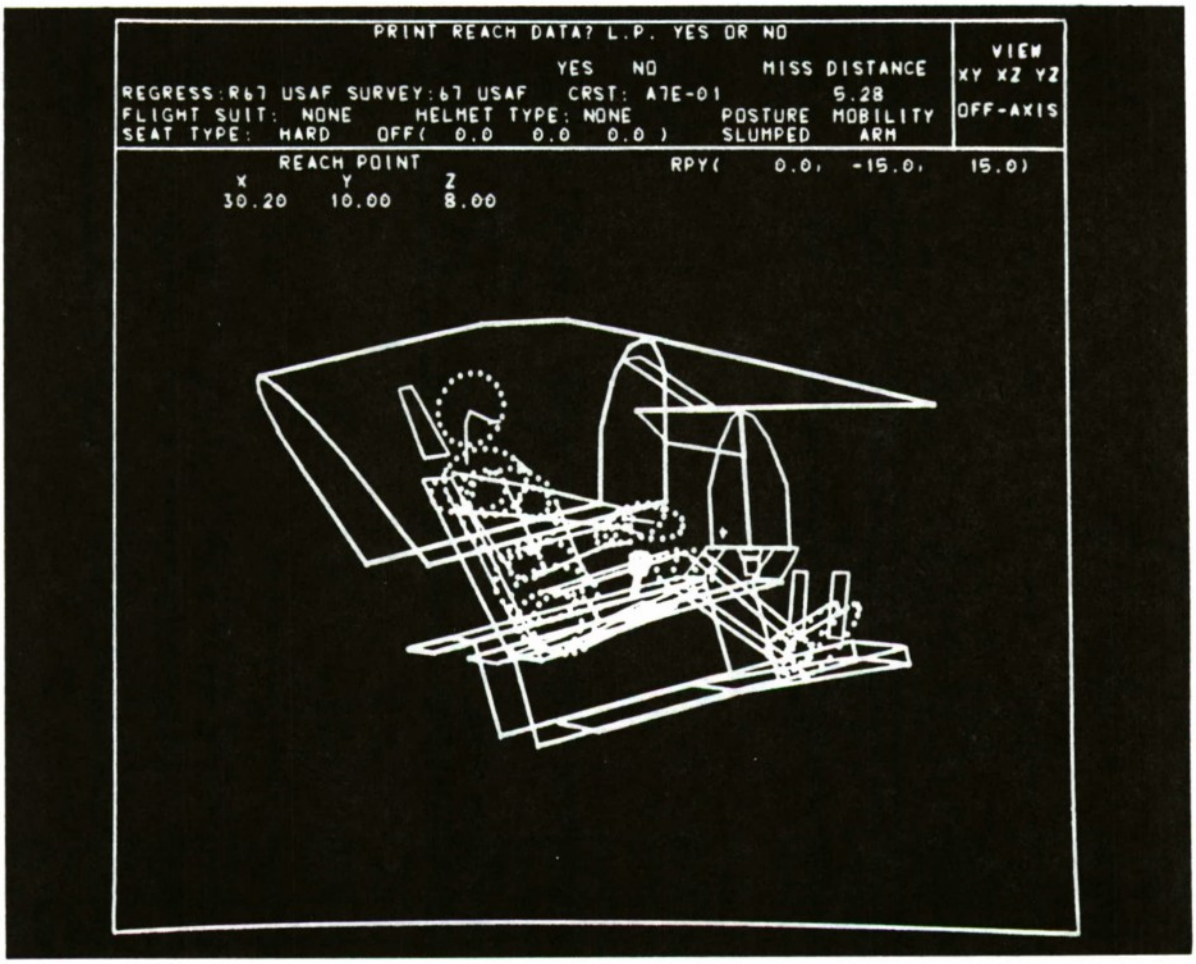

Figure 38. MISS DISTANCE is Displayed if the Man-Model Could Not Reach the Point.

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COMBIMAN REACH ANALYSIS

RCH NO.	RCH TYPE	RCH PT.	DIST. TO RCH PT.	POSTURE	MOBILITY
1	1 LEFT ARM	(27.00, 5.00, 27.00)	0.00	SLUMPED	LAP

Figure 39. PERFORM REACH Function Printout Obtained When User Responds "YES" to Message "PRINT REACH DATA? L.P. YES or NO".

2.2.12 INPUT 12 ANTHROPOMETRIC DIMENSIONS Function (PFK12)

This is one of two methods to define the bodysize of the man-model. The other method is described in Paragraph 2.2.13. The INPUT 12 ANTHROPOMETRIC DIMENSIONS function allows the user to supply values, either as percentiles or as absolute dimensions, for each of the dependent anthropometric variables necessary to construct the link system of the man-model. This function can be selected by depressing PFK12.

There are basically three methods for entering anthropometry using this function: (1) in engineering units with card input, (2) in engineering units through the ANKB, or (3) by selecting a percentile for each variable from a menu on the display.

1) If State Switch 22 is previously set "ON", the message "CARD INPUT ANTH.DIM.? ENTER Y/N" is displayed in the Prompting Area of the CRT. If the answer is "YES" or "Y" through the ANKB, the 12 dependent anthropometric dimensions are read, in the default units of measure, from input cards in the format shown in Figure 40. The function then returns control to the main routine to generate the man-model. If the response is "NO" or "N", or simply the ALT-CODE/5 sequence, or if State Switch 22 is not set "ON" the program bypasses the card input option.

2) When the card input option is bypassed, the message "VALUES IN PCTLS? ENTER Y/N" is displayed in the Prompting Area of the CRT. If the response through the ANKB is "NO" or "N" to this message, the user is then prompted to enter a value in engineering units for each of the 12 dependent variables. The procedure is as follows:

```
128.034.5722.8420.7523.0314.2115.9112.409.02 10.087.44 11.58
140.035.8323.3923.0724.6516.1815.9513.988.82 11.307.84 12.63
147.034.2921.6920.4722.6 12.4415.2013.509.61 9.92 7.13 10.90
152.035.6324.1320.8723.2314.4515.4713.159.80 10.837.36 11.50
159.035.7924.2121.6124.0614.6115.5113.749.33 10.167.40 11.99
164.037.0924.6521.6523.5813.8616.3413.359.76 10.397.52 11.58
172.038.1525.2022.1724.7613.9016.8113.789.41 10.557.36 11.58
181.038.2724.9222.8324.6514.4917.4413.7410.9110.517.68 12.01
187.037.3623.7023.1925.8314.8816.3014.379.57 11.308.19 12.87
196.037.0524.4122.5625.5914.5317.0915.0 10.5910.877.99 12.19
202.036.0223.4724.8426.7715.0416.5415.5510.7111.508.23 12.64
211.036.1424.0622.0924.8814.7617.1314.8011.6511.187.72 11.97
221.039.0226.0222.6025.3515.2016.6514.7210.4310.717.76 11.77
228.039.3325.7922.9925.0 14.3716.4215.3911.0611.307.76 12.99
145.033.9421.3420.3522.7612.9915.8312.959.02 9.65 6.93 10.39
149.034.2521.4621.1023.2713.7015.5913.0310.5110.127.24 11.34
163.034.6922.3621.6123.7413.7816.3013.709.88 9.21 7.01 11.30
164.035.1223.1920.3222.3613.9016.0613.9810.1210.477.28 10.91
150.035.3922.8019.6521.2613.2715.9113.079.57 10.287.09 10.71
140.035.8323.3923.0724.6516.1815.9513.988.82 11.307.84 12.64
175.036.1824.6520.7123.4314.6916.0614.3310.1210.0 7.32 11.65
179.036.6524.2921.3423.9013.9815.9514.6110.6710.477.13 11.77
171.037.1723.1522.1323.3514.2116.7714.6510.1210.957.68 11.44
173.037.5224.0622.8724.2914.7617.8014.029.84 10.718.07 12.24
188.037.9925.3223.2324.8015.0 16.3014.4110.2810.957.60 12.60
177.038.3524.6922.7625.5915.4315.8713.908.98 11.187.95 11.81
192.038.8225.3922.8724.9215.2017.3214.659.88 11.147.64 11.93
160.039.2926.1422.6823.1114.5316.8912.878.39 11.027.87 11.93
184.039.6125.2023.2324.6514.8416.3813.709.21 11.267.64 12.07
133.035.1222.5621.3822.6 13.7814.5313.278.03 10.327.56 11.46
```

Figure 40. DATA SET - COMBIMAN.SMPLANTH (Card Image). Each Card Contains 12 Independent Anthropometric Variable in F5.2 Format to Create a Man-Model.

- The message "DESIRE CHANGE UNIT? ENTER Y/N" will be displayed. The user types "YES" or "Y" and follows the ALT/CODE-5 sequence to change the units for each variable. If the response is "NO" or "N" followed by ALT/CODE-5 sequence, or simply ALT/CODE-5 sequence, the default units are assumed.

NOTE: While value may be entered in any units of measure, they are converted to pounds or inches for processing, display, and printouts.

- The first variable name is then underlined.

  - If the response to the above prompting message is "YES" as shown in Figure 41 then the message "L.P. NEW UNIT, IF DESIRED" is displayed as shown in Figure 42. The user may light pen a new unit from the menu of allowable units (in, cm, mm, lb, or kg), or perform ALT-CODE/5 sequence to retain the default unit for that variable. Then the message "ENTER NEW VALUE" appears in the Prompting Area as shown in Figure 43. The process repeats for each variable (see Figure 44).

  - If the response to the prompting message "DESIRE UNIT CHANGE? ENTER Y/N" is "NO", the message "ENTER NEW VALUE" immediately appears in the Prompting Area of the CRT.

- The user types in the numeric quantity in the appropriate units followed by the ALT-CODE/5 sequence. The process then repeats as each of the 12 dependent variable names is underlined. Control is then returned to the main routine for man-model generation.

NOTE: Since the unit of measurement is declared for each number entered, the numbers need not be in the same units, that is, inches, centimeters, and millimeters; and pounds and kilograms. These units may be mixed as desired. Alternatively, since pounds and inches are the default units of measure, the user may select these by using the ALT-CODE/5 sequence rather than using the light pen.

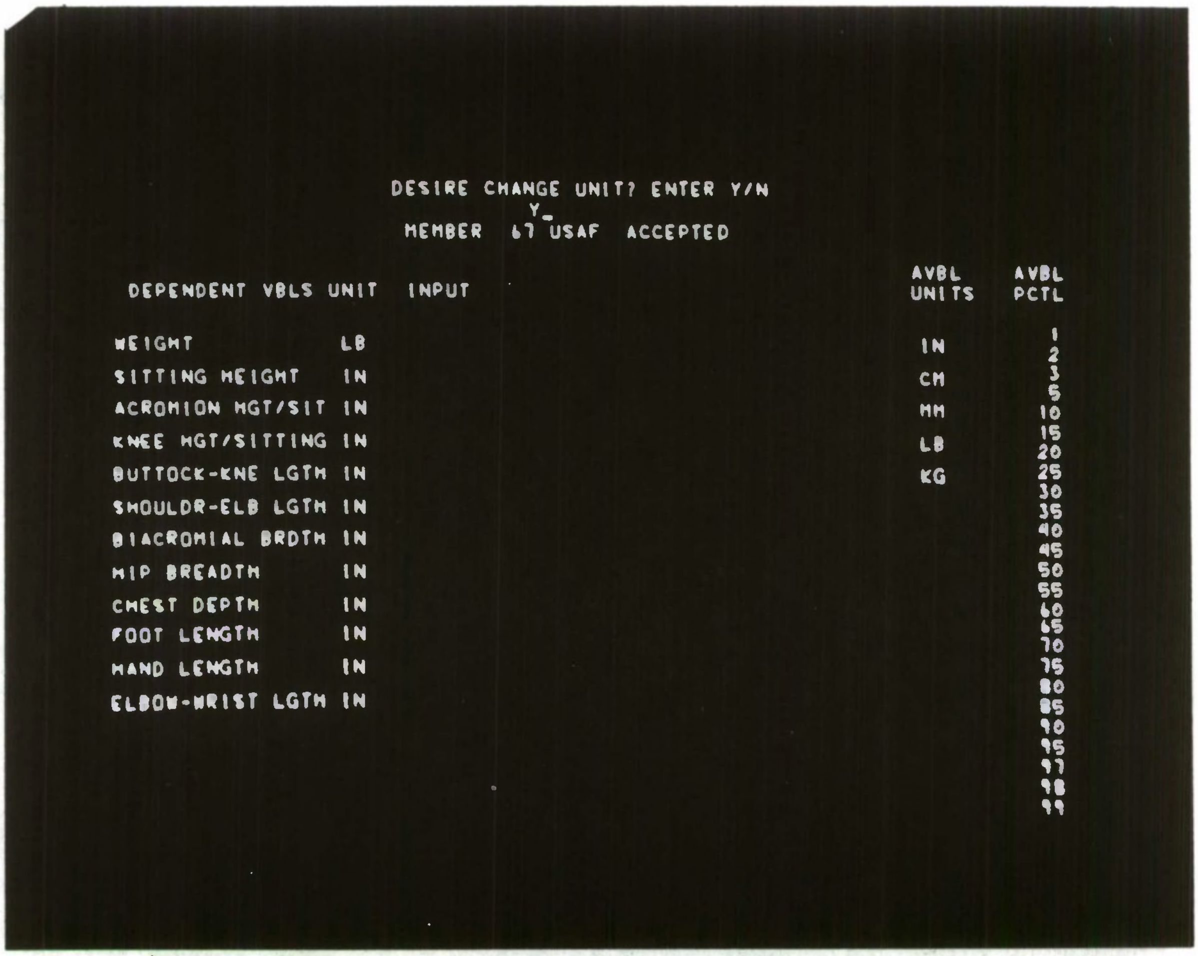


Figure 41. INPUT 12 ANTHROPOMETRIC DIMENSIONS Function Option to Change Input Unit When Entering Values in Engineering Units.

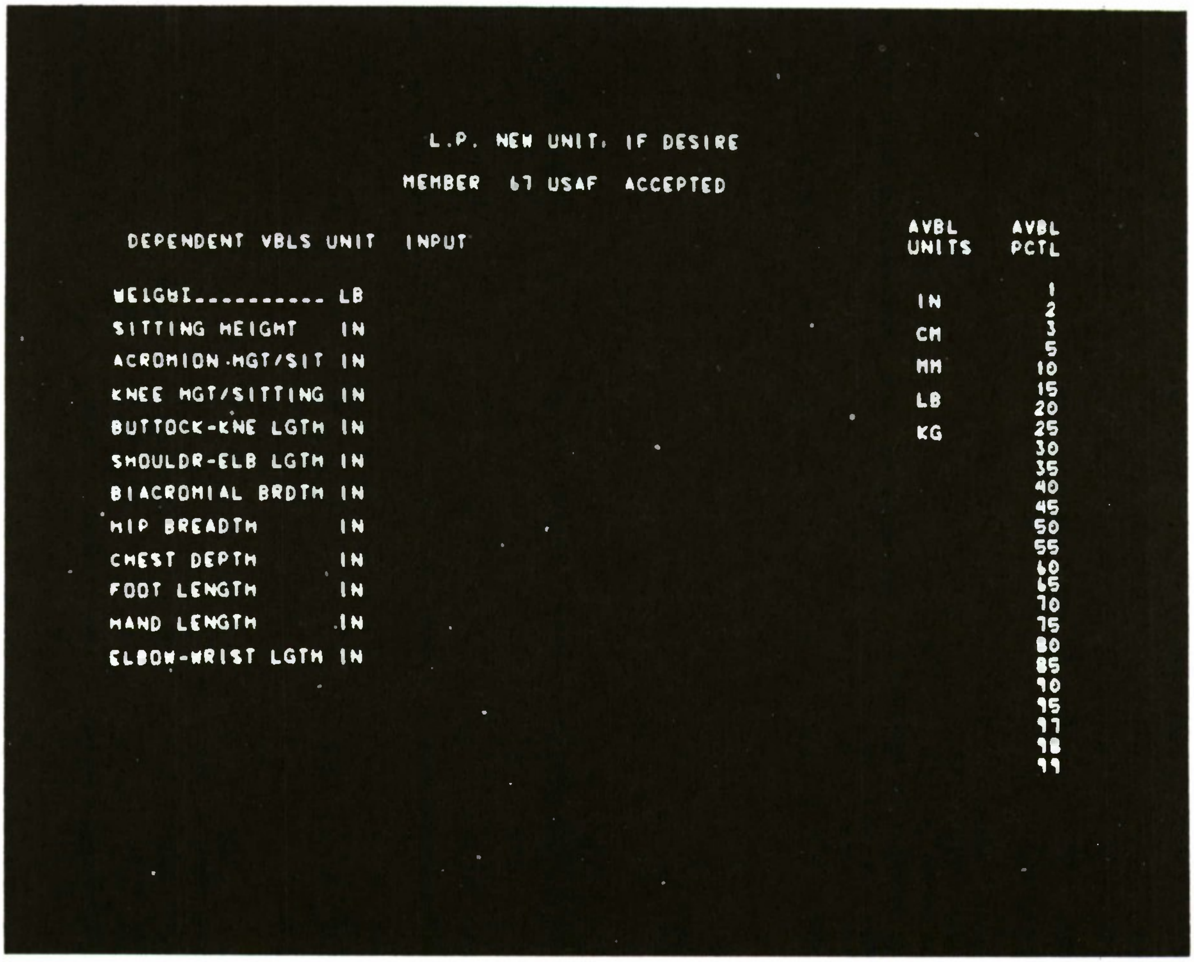


Figure 42. INPUT 12 ANTHROPOMETRIC DIMENSIONS Function Choose New Unit for Input Value.

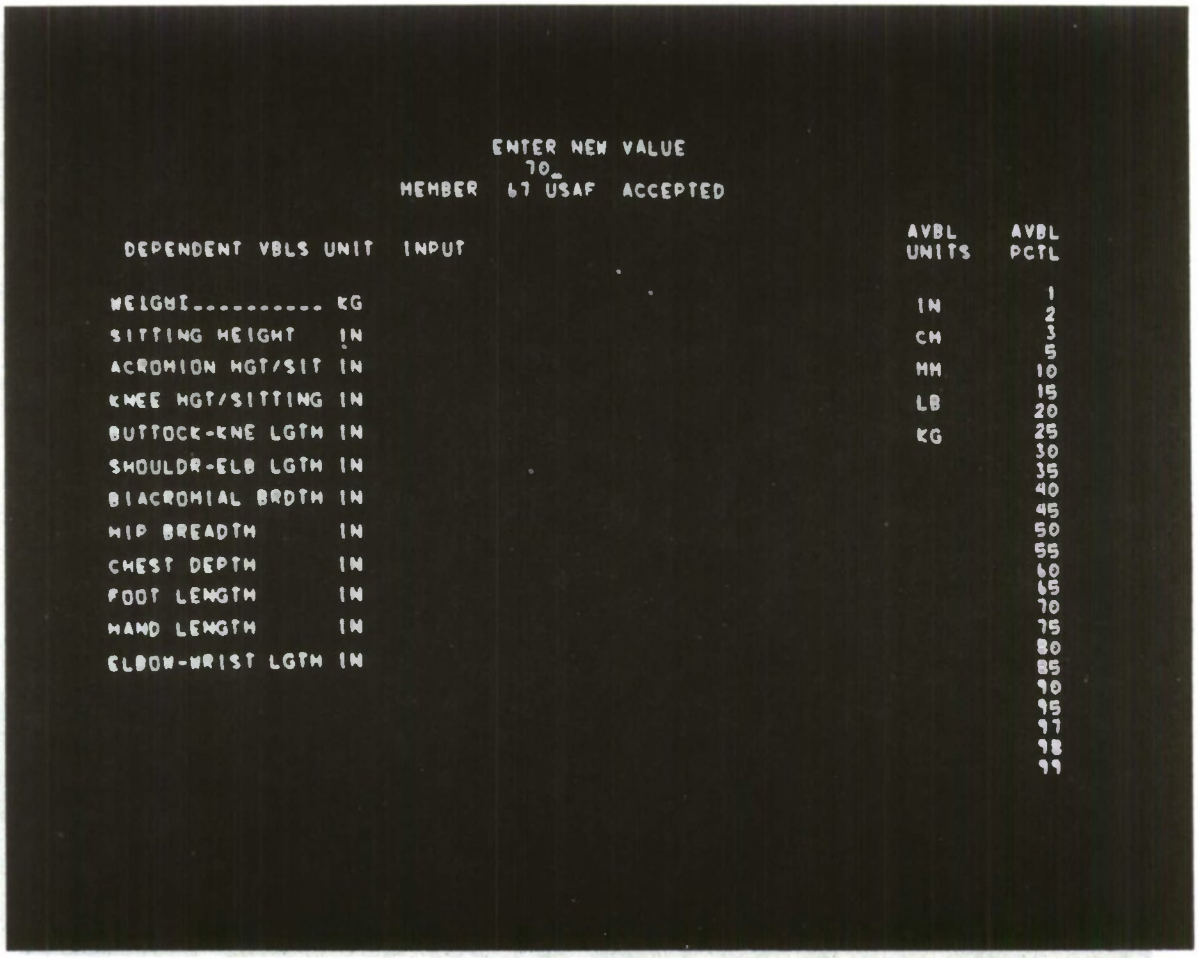


Figure 43. INPUT 12 ANTHROPOMETRIC DIMENSIONS Function Sample Input in Engineering Unit.

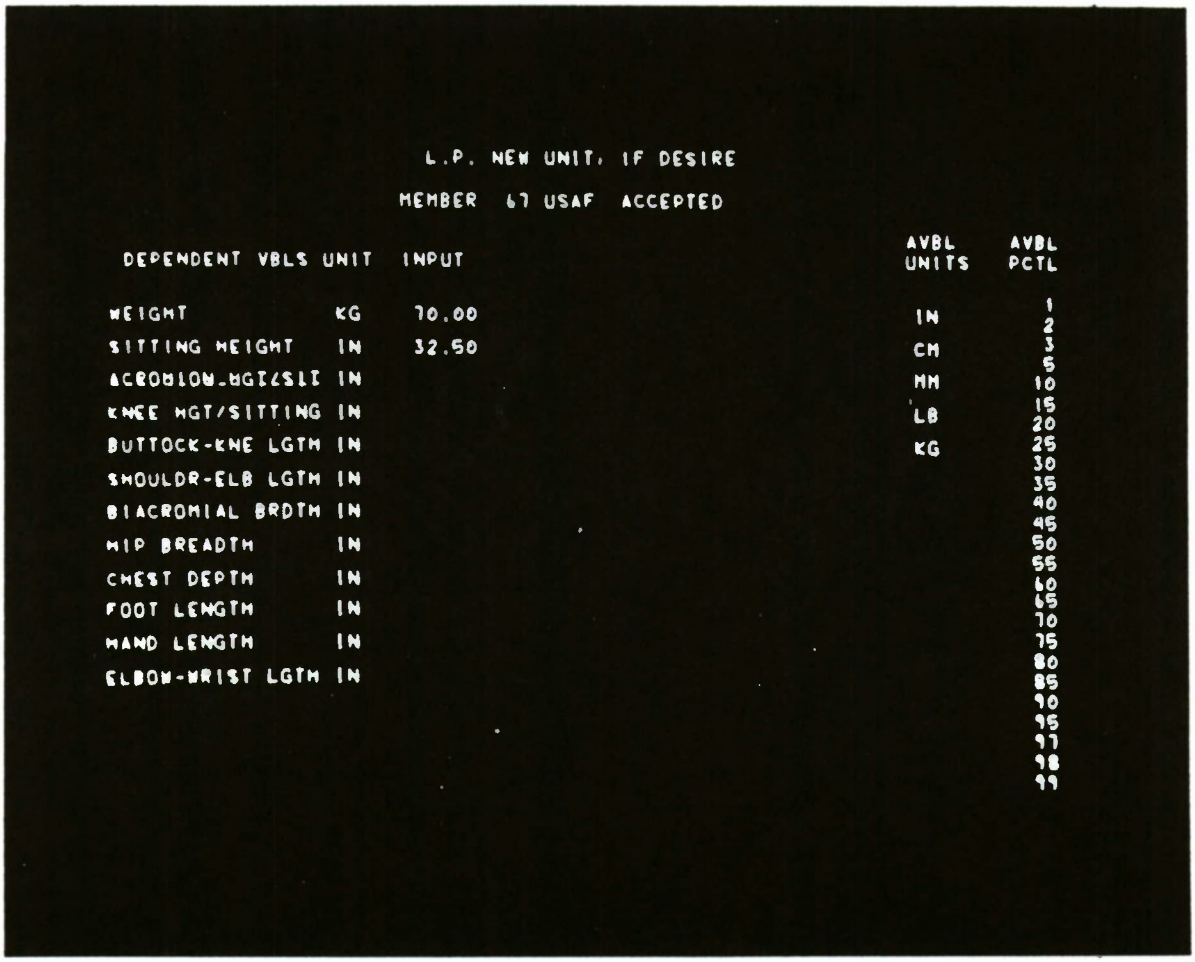


Figure 44. INPUT 12 ANTHROPOMETRIC DIMENSIONS Function Choose New Unit, if Necessary, for the Next Input Variable.

3) If the card input option is bypassed and the user responds "YES" or "Y" or simply ALT-CODE/5 to the prompting message "VALUE IN PCTLS? ENTER Y/N", (see Figure 45) values are entered for each of the 12 dependent variables as a percentile of the survey chosen in the first step of the Define Anthropometry function as follows.

- The first variable name is underlined and the user receives the prompt "L.P. PERCENTILE".

- The user then light pens the desired percentile from the menu of available percentiles on the right side of the Display Area. The above procedure is repeated for each of the 12 dependent variables. Figure 46 shows the Display after defining the first two variables. Control then returns to the main program for man-model generation.

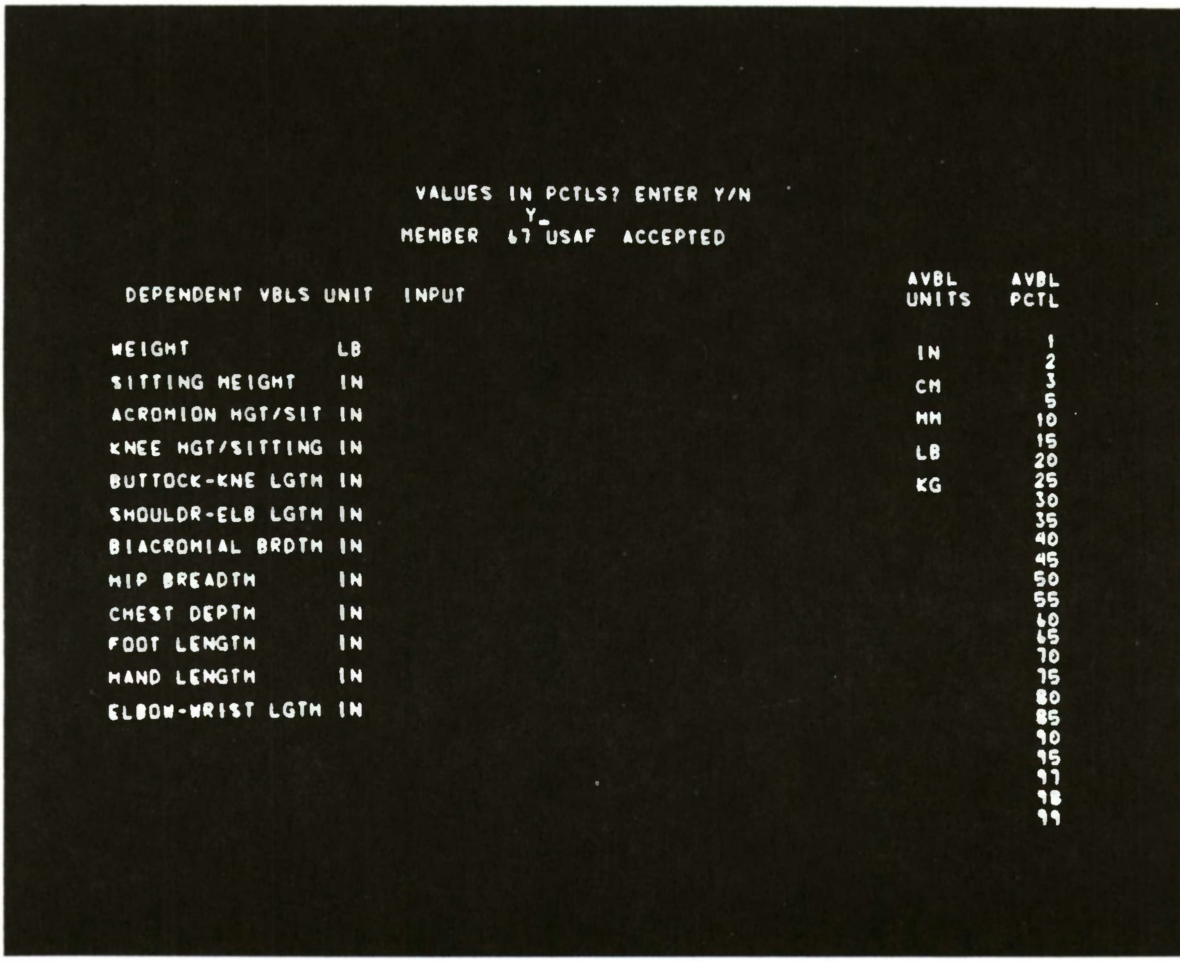


Figure 45. INPUT 12 ANTHROPOMETRIC DIMENSIONS Function Option to Choose Input Values in Percentile or in Engineering Units.

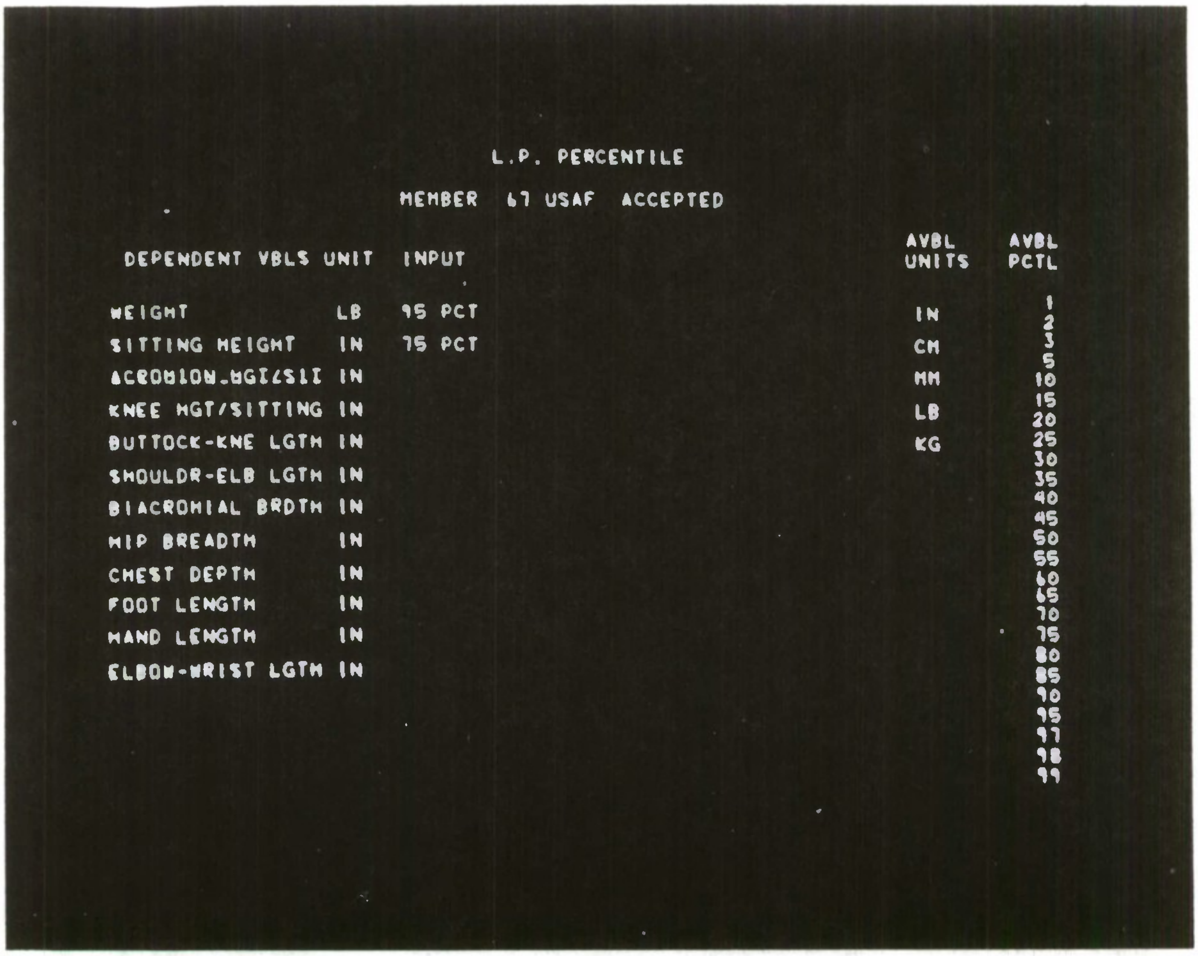


Figure 46. Light Pen Percentile Values for the INPUT 12 ANTHROPOMETRIC DIMENSIONS Functions. The first two values have been defined in percentiles; the third value is underlined, indicating its value will be defined by the next selected percentile value.

2.2.13 INPUT TWO INDEPENDENT VARIABLES Function (PFK13)

This is one of two methods to define the size of the man-model, the other method is described in Paragraph 2.2.12.

The INPUT TWO INDEPENDENT VARIABLES function provides the user with the opportunity to select two relevant anthropometric variables and to enter their values. One of these variables is highly correlated to the mass variables of the man-model, and the other is highly correlated to the length variables. One of the advantages of using this function is that the user need not specify values for all 12 dependent anthropometric dimensions, as with PFK12 (Paragraph 2.2.12). Instead, the user selects two key variables most relevant to the design or evaluation problem. The program will calculate values for the remaining dependent variables using regression equations. Values supplied by the user can be either in percentiles of the selected anthropometric survey member, or in engineering units.

After depressing PFK13, the CRT is formatted as shown in Figure 47. The left and center portions of the screen contain the columns of mass and length related variables, respectively. To the right of each variable name is the default or pre-defined unit of measurement. The right portion of the screen contains a column of alternative units of measurement, labeled "AVBL UNITS", and a column of percentile names, labeled "AVBL PCTL", for which values can be obtained from the selected survey member.

The program places realistic constraints on the second variable, so the variable chosen first must be the most important one. For example, if the length dimension is more

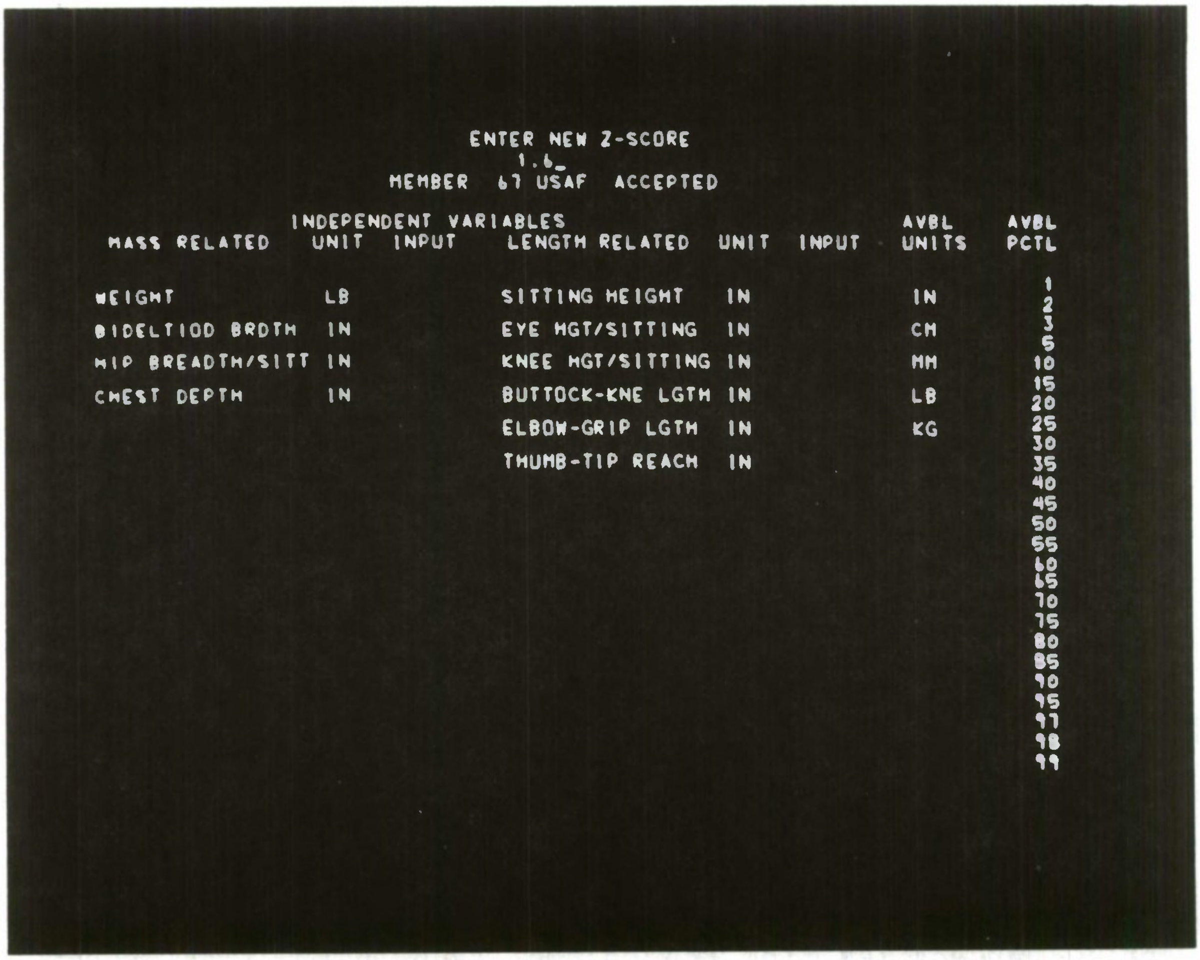


Figure 47. INPUT TWO INDEPENDENT VARIABLES Function Input New Z Score (Default Value is 1.65).

important than the weight, a length related variable must be selected first. Based on the value of the first entry, the second entry is constrained within a certain range as displayed in the information area of Figure 51. This range is set at $\pm$ 1.65 standard deviations from the best estimate derived from the first value entered. This range can be redefined by the user as follows:

The first prompting message is "ENTER NEW Z-SCORE" as shown in Figure 47. This Z-score[1] value is used in the equation which calculates the range of permissible values for the <u>second</u> independent variable selected. If the default value of <u>1.65</u> is retained, the permissible range will include approximately 90% of all possible values for the second variable. Increasing the Z-score will increase the range and decreasing the Z-score will decrease the range. The value the user types in must fall between -3.0 and +3.0. If the default value of 1.65 is suitable, the user may respond by performing the ALT-CODE/5 sequence. Otherwise, type the new value and enter it by the ALT-CODE/5 sequence.

The next message is "VALUES IN PCTLS? ENTER Y/N" (see Figure 48). If the user's response is "YES" or "Y" or just the ALT-CODE/5 sequence, values will be input by light-penning percentiles from the column "AVBL PCTL". The sequence is shown in Figures 48, 49, 50, and 51. If the response is "NO" or "N", values for the selected variables will be entered in Engineering units using the alphanumeric keyboard. For values to be input as percentiles, Table 1 shows the sequence of displayed messages and user responses to be followed. If the values are supplied through the alphanumeric keyboard, the

[1]Z-score represents the extent to which an individual value falls above or below the mean of a set of data.

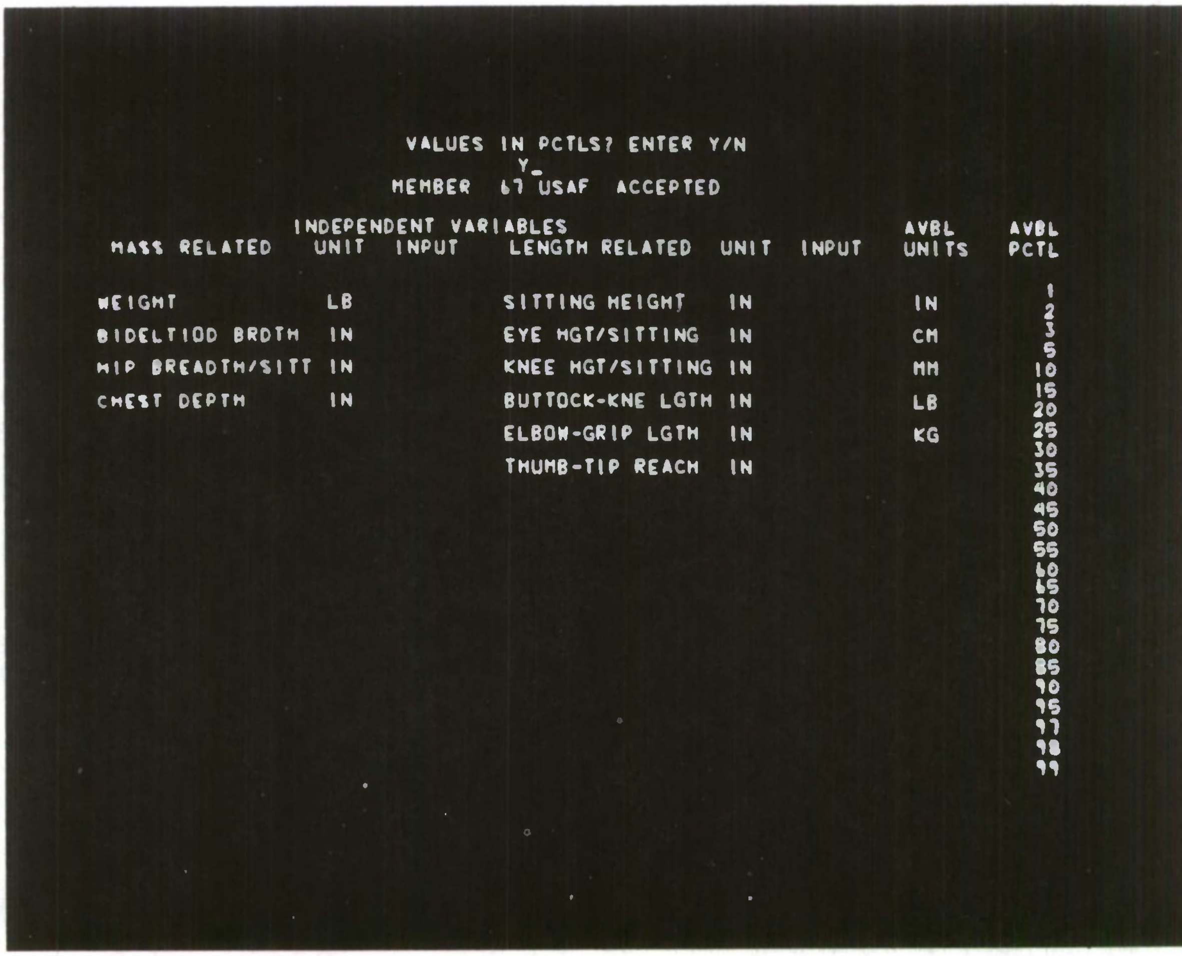


Figure 48. INPUT TWO INDEPENDENT VARIABLES Function Option to Choose Input Values in Percentile or in Engineering Unit.

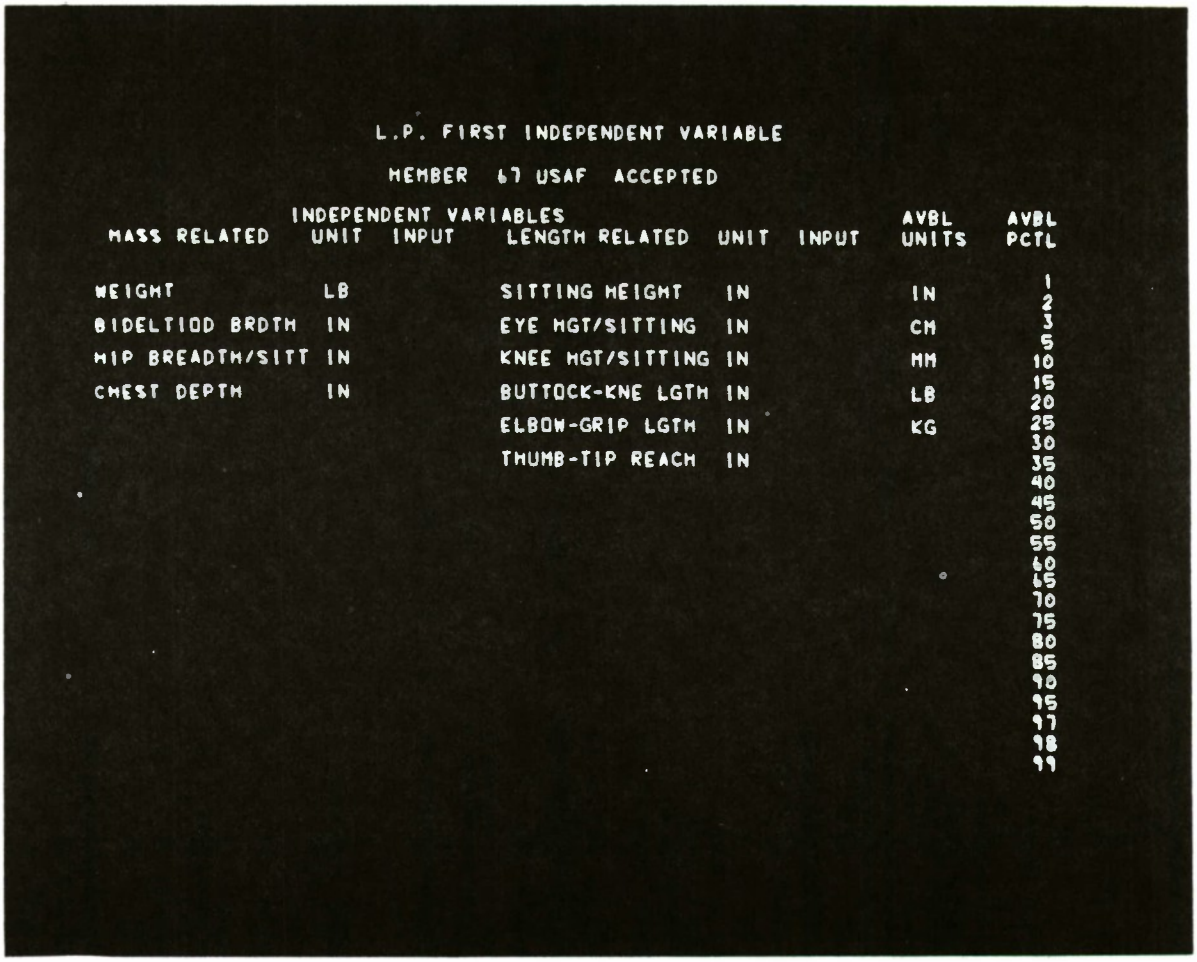


Figure 49. INPUT TWO INDEPENDENT VARIABLE Function
Light-Pen First Independent Variable.

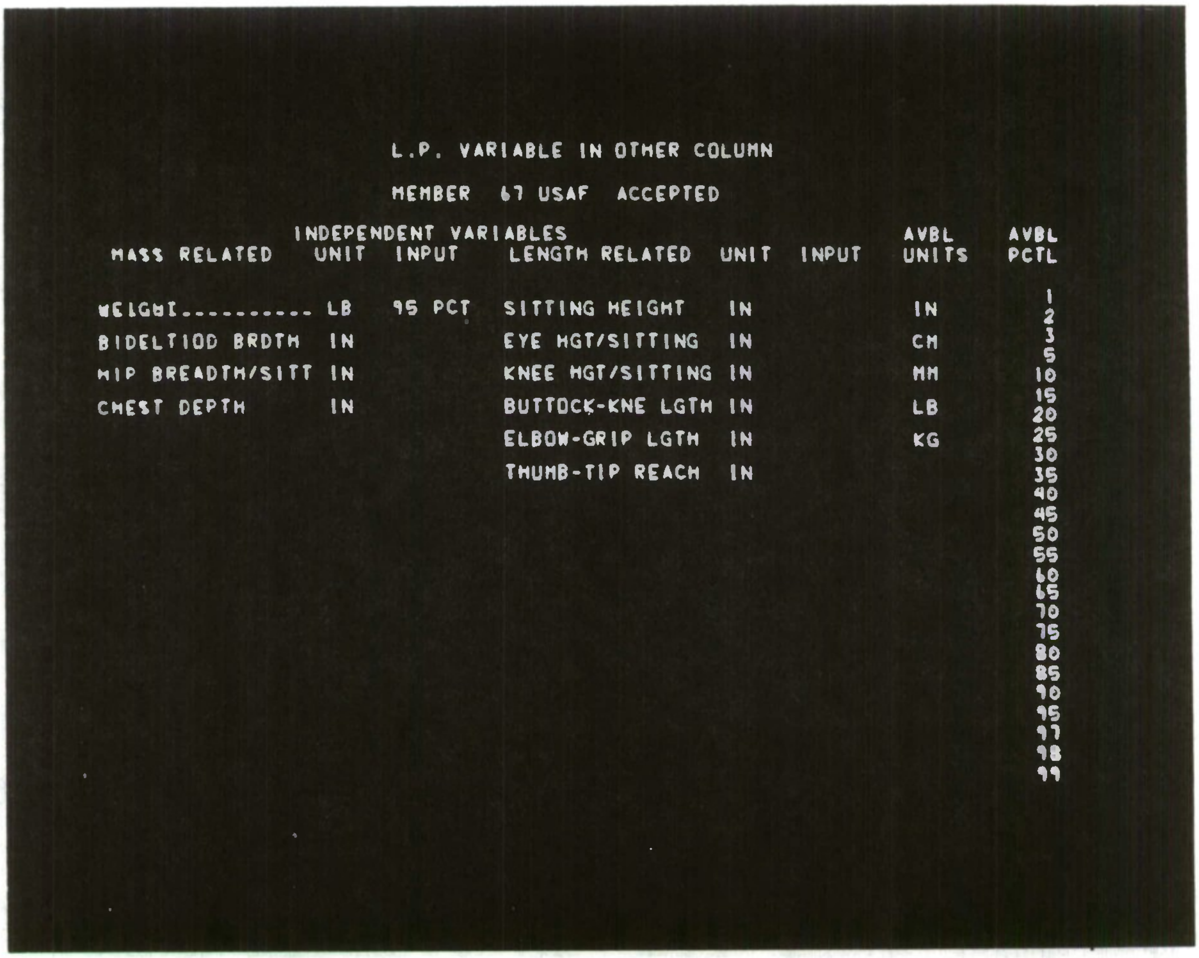


Figure 50. INPUT TWO INDEPENDENT VARIABLE Function Light-Pen Second Independent Variable.

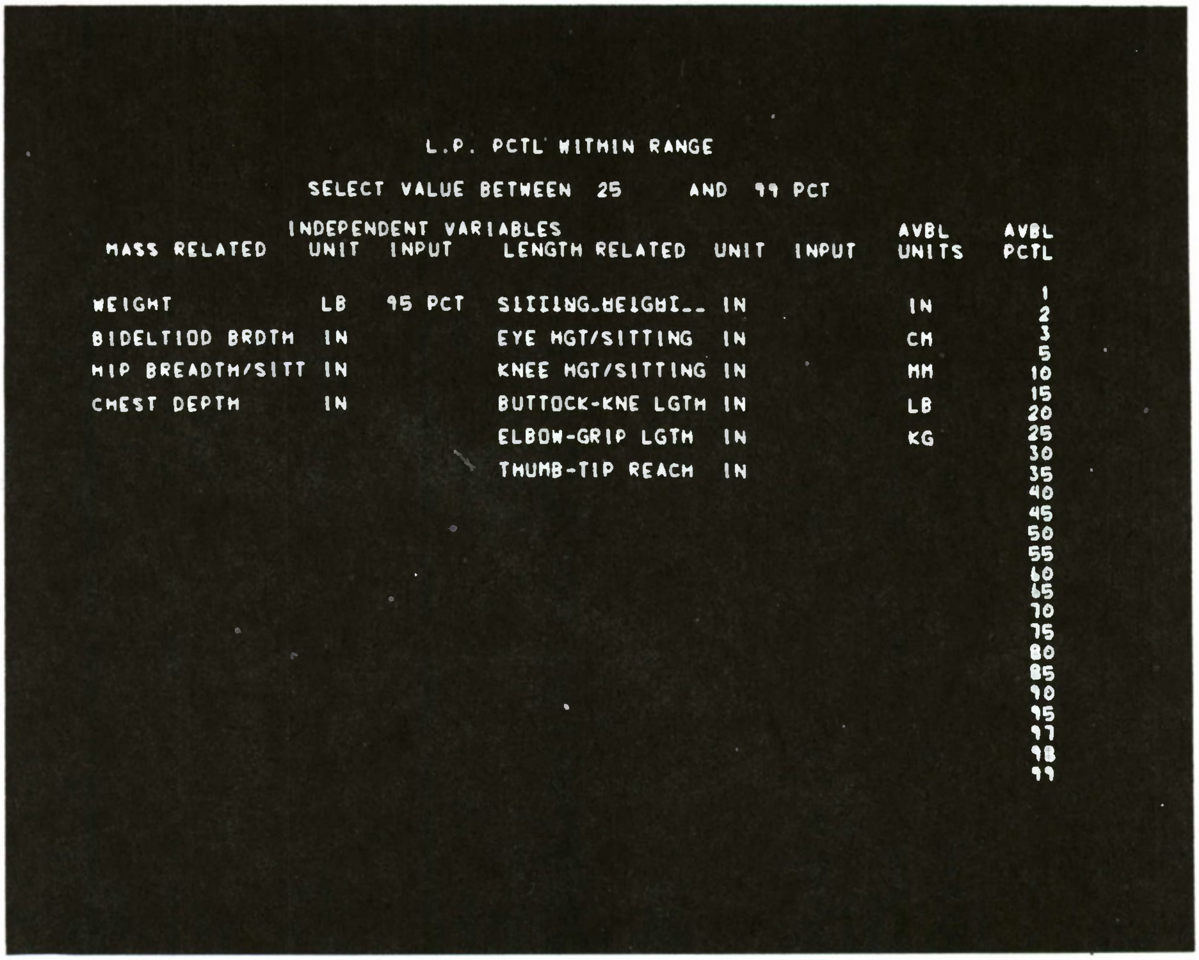


Figure 51. INPUT TWO INDEPENDENT VARIABLE Function Light-Pen Percentile for the Second Independent Variable Within Range.

TABLE 1

PROGRAM MESSAGES AND USER RESPONSES FOR PFK13
WHEN VALUES WILL BE INPUT AS PERCENTILES

(Program Responses Are Listed in Parenthesis)

PROGRAM MESSAGES	USER RESPONSES
L.P. FIRST INDEP. VARIABLE	Light pen a variable from either mass or length column. See Figure 49. (Selected variable will be underlined by program.)
L. P. PERCENTILE	Light pen percentile number from the column "AVBL PCTL". (Selected percentile will be displayed next to underlined variable.)
L.P. VBL IN OTHER COLUMN	Light pen a variable from the column not selected the first time. See Figure 50. (Selected variable will be underlined, if it is in the other column, and a permissible range of percentile values will be displayed in the information area. See Figure 51.)
L.P. PCTL WITHIN RANGE	Light pen a percentile number from the column "AVBL PCTL" which lies within the range of values displayed. See Figure 41. (Selected percentile will be checked and displayed next to underlined variable.)

user should use Table 2 as a guide to the sequence of system messages and user responses. Once the independent values are supplied, the program calculates the surface dimensions required to construct the link system of the man-model. These dimensions are calculated using multiple regression equations from the selected regression member with the user supplied dimensions.

TABLE 2

PROGRAM MESSAGES AND USER RESPONSES FOR PFK13 WHEN VALUES WILL BE INPUT AS ABSOLUTE DIMENSIONS

(Program Responses Are Listed in Parenthesis)

PROGRAM MESSAGES	USER RESPONSES
1. VALUES IN PCTLS? ENTER Y/N	Enter "NO" or "N" through the ANKB followed by the ALT-CODE/5 sequence. Y is the default value.
2. DESIRE UNIT CHANGE? ENTER Y/N	If input units are other than inches and pounds, enter "YES" or "Y" through the ANKB followed by the ALT-CODE/5 sequence. "NO" is the default value.
3. L.P. FIRST INDEP. VARIABLE	Light pen a variable from either mass or length column. (Selected variable is underlined.)
4. L.P. NEW UNIT, IF DESIRED (If response to message 2 is "YES".)	If a unit of measurement other than the one listed next to the underlined variable is desired, light pen a new unit from the column "AVBL UNITS". If no change is desired, press ALT-CODE/5 sequence. The system checks that the unit is valid for the type of variable and displays it next to the input value. It also checks for the value to be within range for the selected survey.
5. ENTER NEW VALUE	Type in real number value through the ANKB, followed by the ALT-CODE/5 sequence. (Typed value will be displayed next to underlined variable.)
6. L.P. VBL IN OTHER COLUMN	Light pen a variable from the column not selected the first time. Selected variable will be underlined if it is in the proper column.
7. L.P. NEW UNIT, IF DESIRED (If response to message 2 is "YES".)	Light pen a new unit or depress ALT-CODE/5 sequence for default unit. The system check the unit, computes the range and displays the values in the informational area.
8. ENTER NEW VALUE	Type in real number value within the displayed range, through the ANKB, followed by the ALT-CODE/5 sequence. (Typed value will be verified and displayed next to the underlined variable.)

2.2.14 DISPLAY TABLE Function (PFK14)

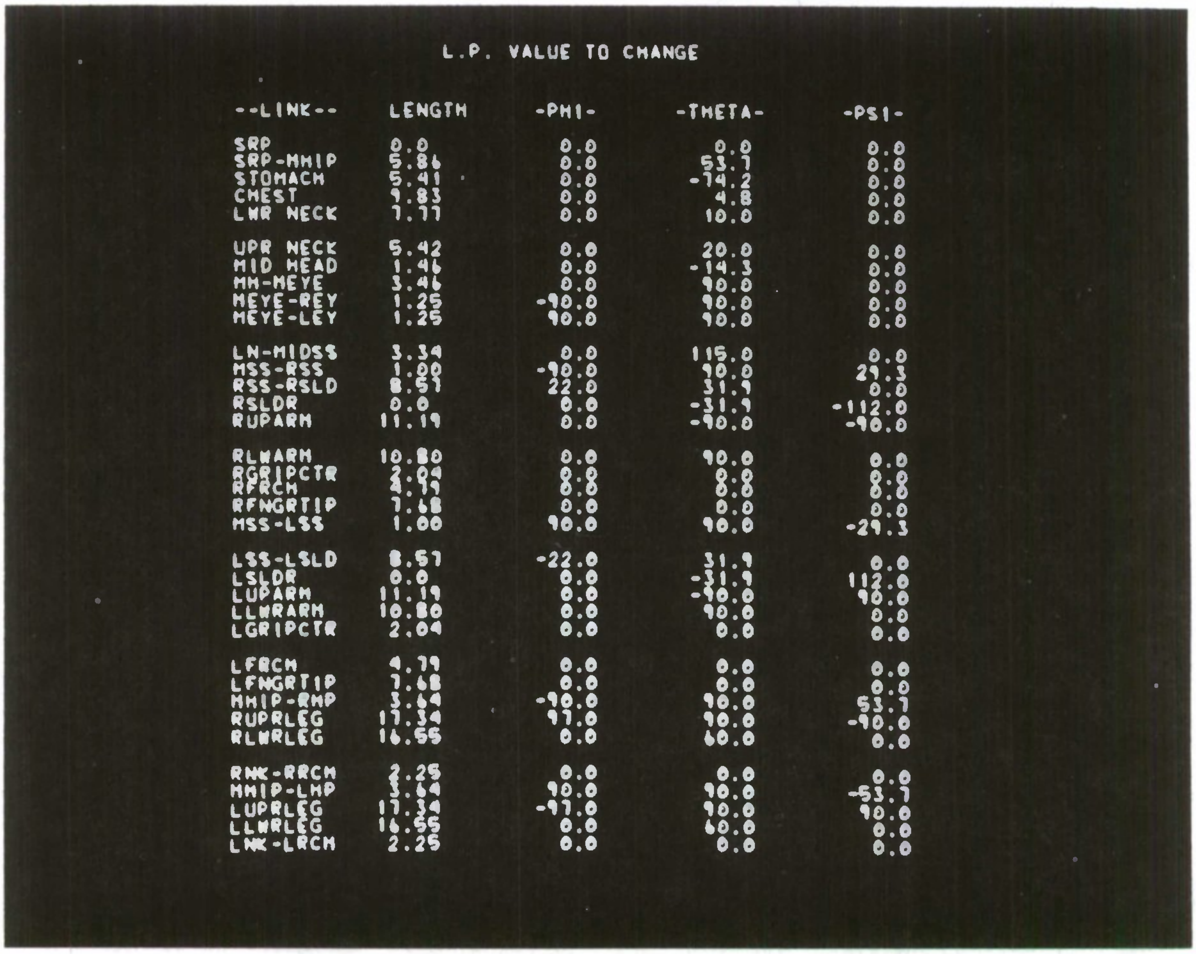
The DISPLAY TABLE function provides the user with the opportunity to inspect the table of link dimensions and angles and make changes to any or all of the values, if necessary. Since the table displays internal link lengths, the anthropometry of the man-model should be defined prior to using this function. Figure 52 shows an example of a Display Table.

The user can modify the values in the Display Table by light-penning the value to be changed, typing a new value, and performing ALT-CODE/5 sequence (see Figure 53). When all changes are made the user performs the ALT-CODE/5 sequence to display the new man-model. The transformation angles in this display can be modified to place the man-model in any desired position (see Paragraph 2.2.21).

Other than the choices of slumped or erect posture, and the reposturing in the reach analysis, using the LINK TABLE to change the joint angles is the user's most important method to change the body position of the man-model. To properly use this table refer to Table 3 for all link definitions.

As described in Section 1, the link system is a series of vectors added together. Each link vector has a local coordinate system with its origin at the distal end. The orientation of the next link is defined in this local coordinate system. The Phi, Theta, and Psi correspond to Euler angles as shown in Figure 54. Since these local coordinate systems are usually not aligned with the base system which has its origin at SRP, no rule can be given for selecting a particular direction of movement. The user should try angular changes one-by-one to obtain desired results.

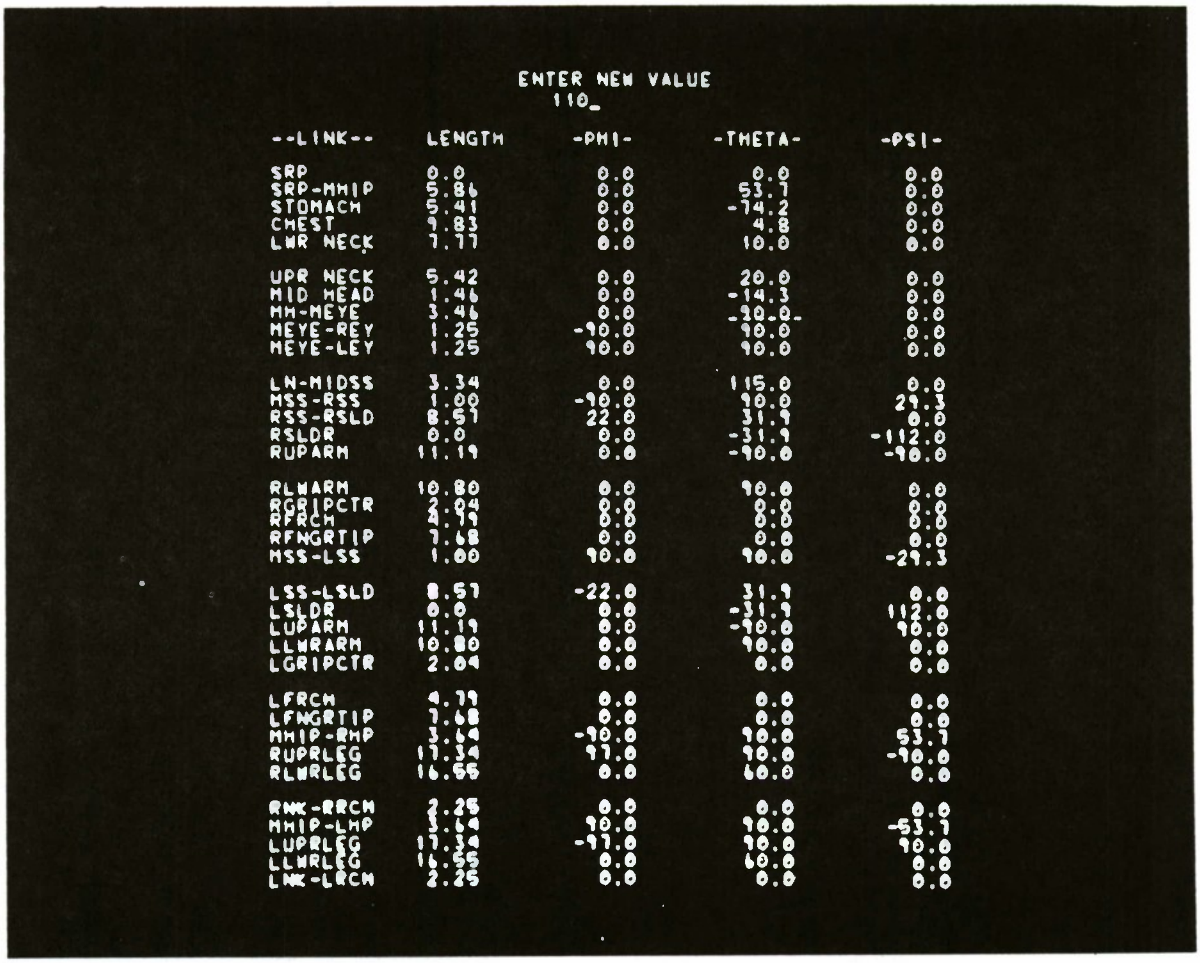
Any change made in link length is reflected in the man-model for all postures. However, changes made in angles are reflected only in PROGRAMMED Posture.



L.P. VALUE TO CHANGE

--LINK--	LENGTH	-PHI-	-THETA-	-PSI-
SRP	0.0	0.0	0.0	0.0
SRP-MMIP	5.86	0.0	53.7	0.0
STOMACH	5.41	0.0	-74.2	0.0
CHEST	9.83	0.0	4.8	0.0
LWR NECK	7.77	0.0	10.0	0.0
UPR NECK	5.42	0.0	20.0	0.0
MID HEAD	1.46	0.0	-14.3	0.0
MH-MEYE	3.46	0.0	90.0	0.0
MEYE-REY	1.25	-90.0	90.0	0.0
MEYE-LEY	1.25	90.0	90.0	0.0
LN-MIDSS	3.39	0.0	115.0	0.0
MSS-RSS	1.00	-90.0	90.0	29.3
RSS-RSLD	8.57	22.0	31.9	0.0
RSLDR	0.0	0.0	-31.9	-112.0
RUPARM	11.19	0.0	-90.0	-90.0
RLWARM	10.80	0.0	90.0	0.0
RGRIPCTR	2.04	0.0	0.0	0.0
RFRCH	4.79	0.0	0.0	0.0
RFNGRTIP	7.68	0.0	0.0	0.0
MSS-LSS	1.00	90.0	90.0	-29.3
LSS-LSLD	8.57	-22.0	31.9	0.0
LSLDR	0.0	0.0	-31.9	112.0
LUPARM	11.19	0.0	-90.0	90.0
LLWRARM	10.80	0.0	90.0	0.0
LGRIPCTR	2.04	0.0	0.0	0.0
LFRCH	4.79	0.0	0.0	0.0
LFNGRTIP	7.68	0.0	0.0	0.0
MMIP-RMP	3.64	-90.0	90.0	53.7
RUPRLEG	17.34	97.0	90.0	-90.0
RLWRLEG	16.55	0.0	60.0	0.0
RNK-RRCM	2.25	0.0	0.0	0.0
MMIP-LMP	3.64	90.0	90.0	-53.7
LUPRLEG	17.34	-97.0	90.0	90.0
LLWRLEG	16.55	0.0	60.0	0.0
LNK-LRCM	2.25	0.0	0.0	0.0

Figure 52. DISPLAY TABLE Displays Links, Their Lengths and Euler Angles.



ENTER NEW VALUE
110_

--LINK--	LENGTH	-PHI-	-THETA-	-PSI-
SRP	0.0	0.0	0.0	0.0
SRP-MHIP	5.86	0.0	53.7	0.0
STOMACH	5.41	0.0	-74.2	0.0
CHEST	9.83	0.0	4.8	0.0
LWR NECK	7.77	0.0	10.0	0.0
UPR NECK	5.42	0.0	20.0	0.0
MID HEAD	1.46	0.0	-14.3	0.0
MH-MEYE	3.46	0.0	-90.0	0.0
MEYE-REY	1.25	-90.0	90.0	0.0
MEYE-LEY	1.25	90.0	90.0	0.0
LN-MIDSS	3.34	0.0	115.0	0.0
MSS-RSS	1.00	-90.0	90.0	29.3
RSS-RSLD	8.57	22.0	31.9	0.0
RSLDR	0.0	0.0	-31.9	-112.0
RUPARM	11.19	0.0	-90.0	-90.0
RLWARM	10.80	0.0	90.0	0.0
RGRIPCTR	2.04	0.0	0.0	0.0
RFRCH	4.79	0.0	0.0	0.0
RFNGRTIP	7.68	0.0	0.0	0.0
MSS-LSS	1.00	90.0	90.0	-29.3
LSS-LSLD	8.57	-22.0	31.9	0.0
LSLDR	0.0	0.0	-31.9	112.0
LUPARM	11.19	0.0	-90.0	90.0
LLWRARM	10.80	0.0	90.0	0.0
LGRIPCTR	2.04	0.0	0.0	0.0
LFRCH	4.79	0.0	0.0	0.0
LFNGRTIP	7.68	0.0	0.0	0.0
MHIP-RHP	3.64	-90.0	90.0	53.7
RUPRLEG	17.34	97.0	90.0	-90.0
RLWRLEG	16.55	0.0	60.0	0.0
RNK-RRCM	2.25	0.0	0.0	0.0
MHIP-LHP	3.64	90.0	90.0	-53.7
LUPRLEG	17.34	-97.0	90.0	90.0
LLWRLEG	16.55	0.0	60.0	0.0
LNK-LRCM	2.25	0.0	0.0	0.0

Figure 53. DISPLAY TABLE Change THETA Value of MH-MEYE from 90° to 110°.

TABLE 3

LINK SYSTEM DEFINITION

LINK NO.	NAME	DEFINITION
0	SRP	Zero-length link at the SRP
1	SRP-MHIP	SRP to mid-hip
2	STOMACH	Mid-hip to L3/L4 disc
3	CHEST	L3/L4 disc to T8/T9 disc
4	LWR NECK	T8/T9 disc to Tl vertebra
5	UPR NECK	Tl vertebra to atlas
6	MID HEAD	Atlas to mid-head point
7	MH-MEYE	Mid-head point to mid-eye point
8	MEYE-REY	Mid-eye point to right eye
9	MEYE-LEY	Mid-eye point to left eye
10	LN-MIDSS	Tl vertebra to mid-suprasternale
11	MSS-RSS	Mid-suprasternale to right suprasternale
12	RSS-RSLD	Right suprasternale to right shoulder
13	RSLDR	Zero-length link at the right shoulder
14	RUPARM	Right shoulder to right elbow
15	RLWARM	Right elbow to right wrist
16	RGRIPCTR	Right wrist to grip center point
17	RFRCH	Right grip center point to functional reach point
18	RFNGRTIP	Right functional reach point to fingertip reach point
19	MSS-LSS	Mid-suprasternale to left suprasternale
20	LSS-LSLD	Left suprasternale to left shoulder
21	LSLDR	Zero-length link at the left shoulder
22	LUPARM	Left shoulder to left elbow
23	LLWRARM	Left elbow to left wrist
24	LGRIPCTR	Left wrist to grip center point
25	LFRCH	Left grip center point to functional reach point
26	LFNGRTIP	Left functional reach point to fingertip reach point
27	MHIP-RHP	Mid-hip to right hip
28	RUPRLEG	Right hip to right knee
29	RLWRLEG	Right knee to right ankle
30	RNK-RRCH	Right ankle to bottom of the right foot
31	MHIP-LHP	Mid-hip to left hip
32	LUPRLEG	Left hip to left knee
33	LLWRLEG	Left knee to left ankle
34	LNK-LRCH	Left ankle to bottom of left foot

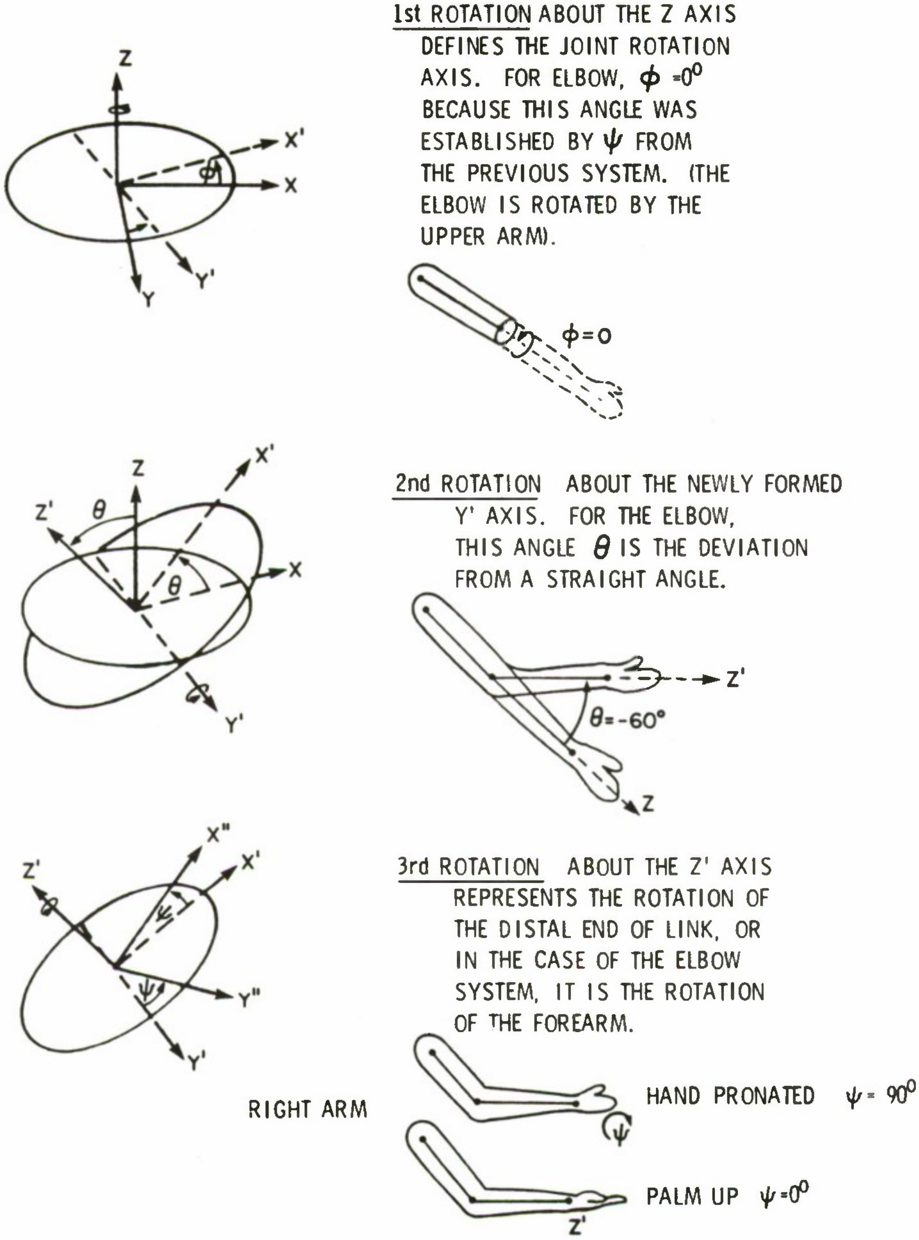


Figure 54. Example of Euler Angle Changes for Elbow Joints.

2.2.15 DUMP CRT Function (PFK15)

The DUMP CRT function plots the display on the 2250 screen to the Gould Plotter. This plot includes the prompting area, the information area, and the COMBIMAN display area. A sample plot of the DUMP CRT function is shown in Figure 55. However, to get a CRT Dump, the Region parameter on STEP1 in Figure 61 has to be changed from 550K to 600K or higher depending on the plotter and the size of the crew station. This plot is different from the on-line plot described in Paragraph 2.2.9 because there is no choice of scale or perspective views and it is a 10" x 10" hard copy plot of the 12" x 12" CRT display. The DUMP CRT function is available to the user at all times like the ALT-CODE/0 cancel option.

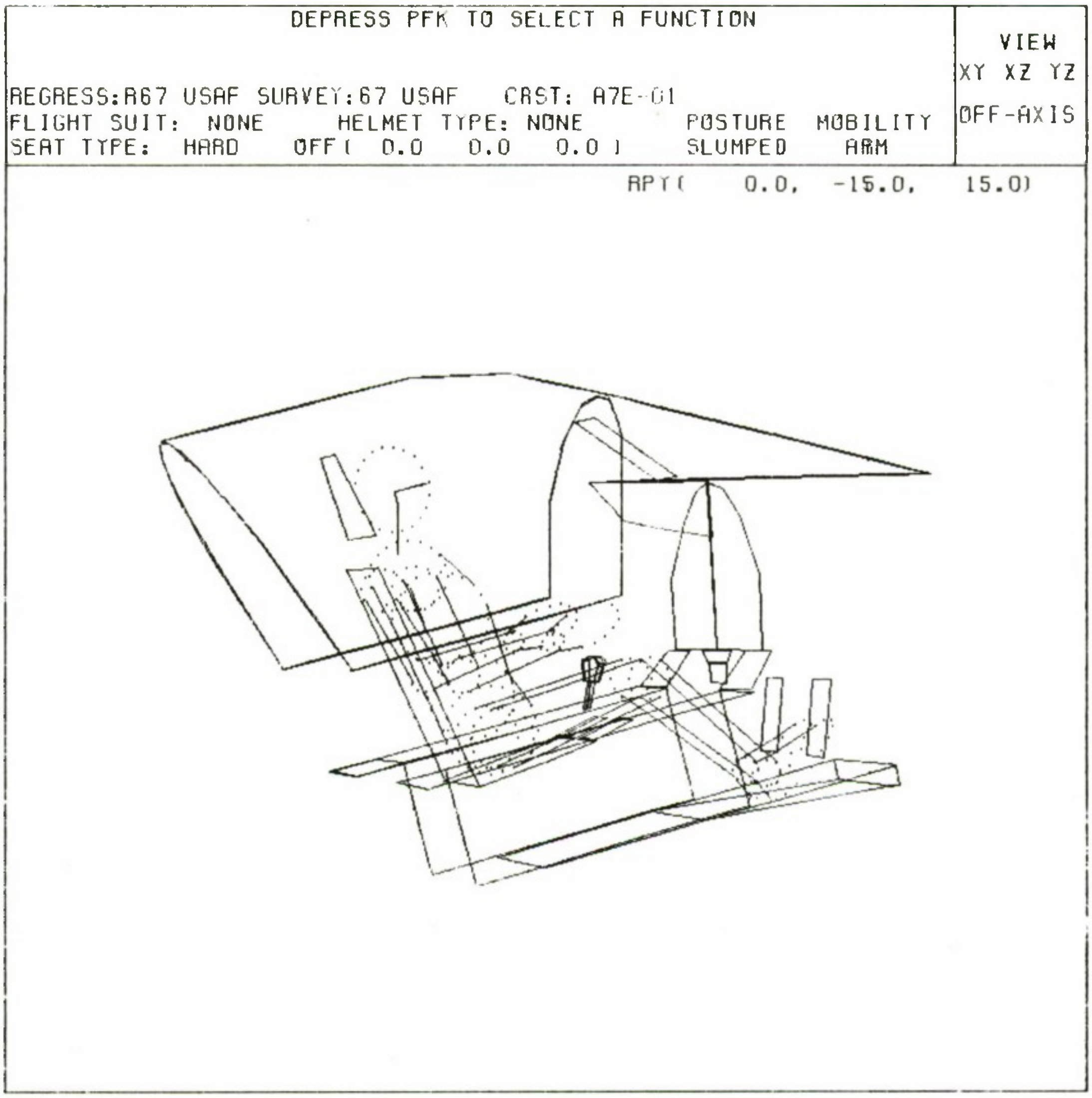


Figure 55. DUMP CRT Function. 2250 Screen Display Plotted on the On-Line GOULD Plotter.

2.2.16 DESIGN PANEL Function (PFK16)

The DESIGN PANEL function allows the user to add a panel to an existing crew station, or design a new crew station by assembling a series of new panels.

In response to prompting message "ENTER PANEL NAME" the user must type a panel name of up to eight characters and enter it by performing ALT-CODE/5 sequence. To the prompting message "ENTER PANEL TYPE" the user should enter a type number "1" for general crew station, "2" for seat panel, and "3" for rudder or brake pedal through the ANKB followed by ALT-CODE/5 sequence. Finally as a response to the message "ENTER NUMBER OF VERTICES" the user must supply the number of vertices for the new panel. The number of vertices must be 3, 4, 5, or 6. Then with the cross symbol "+" and the lighted PFKs (see Figure 33), the user defines the vertices of the panel, one at a time, in the X-Z plane and then in the Y-Z plane using the method described in Paragraph 2.2.11.1*.

As mentioned in Paragraph 2.2.11, PFK12 is used to stop the "+" while in motion. When PFK12 is depressed twice consecutively, the location of the vertex is defined in the displayed view. When subsequent vertices are defined, they are automatically connected by lines.

The panel thus defined can be treated like any other panel. It will not, however, be automatically added to the permanent Crew Station Data Base.

The newly designed panel name and coordinates will appear on the printout as shown in Figure 56.

The panel will be erased when the "ERASE" option of the RETRIEVE CREW STATION function is selected again.

---

*The program assigns the lowest unused sequence number as the "internal reference number" for this new panel.

```
CBM0011 COMBIMAN V5, DATE= 5/ 1/81, TIME= 9. 1.21.
CBM0331 REGRESSION VALUES FROM MEMBER R67 USAF.
CBM0151 SURVEY DATA FROM 67 USAF
CBM0451 USER CHOOSES TO INPUT 2 INDEPENDENT VARIABLES
CBM0411 INPUT VARIABLES WILL BE IN PERCENTILES.
SITTING HEIGHT         50 PCT              36.650  IN
WEIGHT                 50 PCT             172.420  LB
-----COMPUTER CALC. DEP. VALUES-----
NO.     VBL. NAME           VALUE    UNIT
---  ----------------    --------  ----
  1  WEIGHT               172.420   LB
  2  SITTING HEIGHT        36.650   IN
  3  ACROMION HGT/SIT      24.012   IN
  4  KNEE HGT/SITTING      21.940   IN
  5  BUTTOCK-KNE LGTH      23.771   IN
  6  SHOULDR-ELB LGTH      14.143   IN
  7  BIACROMIAL BRDTH      16.015   IN
  8  HIP BREADTH           13.851   IN
  9  CHEST DEPTH            9.625   IN
 10  FOOT LENGTH           10.631   IN
 11  HAND LENGTH            7.520   IN
 12  ELBOW-WRIST LGTH      11.802   IN
CBM0091  SWITCH 20 ON
CBM0521  VISIBILITY PLOT GENERATED FOR A7E-CI
CBM0141  C/S DATA FROM A7--SEAT
CBM0141  C/S DATA FROM A7E-CI
CBM0071   87.) NEWPNL   , TYPE= 1, 4 VERTICES
CBM0071 23.50  0.0  21.00 23.50  0.0  17.80 27.50  0.0  16.40 27.50  0.0  19.20
CBM0091  SWITCH  6 ON
CBM0091  SWITCH 72 ON
CBM0331  REGRESSION VALUES FROM MEMBER R67 USAF.
CBM0151  SURVEY DATA FROM 67 USAF
CBM0451  USER CHOOSES TO INPUT 2 INDEPENDENT VARIABLES
CBM0411  INPUT VARIABLES WILL BE IN PERCENTILES.
SITTING HEIGHT         50 PCT              36.650  IN
WEIGHT                 50 PCT             172.420  LB
-----COMPUTER CALC. DEP. VALUES-----
NO.     VBL. NAME           VALUE    UNIT
---  ----------------    --------  ----
  1  WEIGHT               172.420   LB
  2  SITTING HEIGHT        36.650   IN
  3  ACROMION HGT/SIT      24.012   IN
  4  KNEE HGT/SITTING      21.940   IN
  5  BUTTOCK-KNE LGTH      23.771   IN
  6  SHOULDR-ELB LGTH      14.143   IN
  7  BIACROMIAL BRDTH      16.015   IN
  8  HIP BREADTH           13.851   IN
  9  CHEST DEPTH            9.625   IN
 10  FOOT LENGTH           10.631   IN
 11  HAND LENGTH            7.520   IN
 12  ELBOW-WRIST LGTH      11.802   IN
CBM0021  PROGRAM END.
```

Figure 56. Printed Output of the Newly Designed Panel NEWPNL is Within the Box.

2.2.17 DELETE PANEL Function (PFK18)

The DELETE PANEL function allows the user to remove a crew station panel from the display. It does not remove the panel from the Crew Station Data Base. Once deleted, the panel cannot be recalled using the INCLUDE OBJECT function. It must be either recreated by the DESIGN PANEL function, or the entire crew station must be recalled again using the RETRIEVE CREW STATION function in Paragraph 2.2.6. In both cases, the crew station will be reset to its original configuration.

To delete a panel, the name of the panel must be entered through the ANKB as response to prompting message "ENTER PANEL NAME". If the specified panel does not exist, the program repeats the prompt until the user specifies an existing panel, or performs ALT-CODE/5 sequence. If no name is specified by signaling only ALT-CODE/5 sequence, the function request is ignored and no deletion occurs. The panel name can be found with the IDENTIFY OBJECT function described in Paragraph 2.2.2.

The DELETE PANEL function is different from the OMIT OBJECT function because this function deletes the panel from the display and cannot be redisplayed by invoking the INCLUDE OBJECT function.

2.2.18 CHANGE PERSPECTIVE Function (PFK22)

The CHANGE PERSPECTIVE function allows the user to change the point of view and/or the effective viewing distance between the displayed man-model and the crew station. This function is useful in enhancing the perspective and therefore the three dimensional character of the displayed image.

To activate the CHANGE PERSPECTIVE function, first depress PFK22. The program displays the message "VIEW ADJUST" and temporarily redefines PFKs 1, 2, 3, 4, 5, 6, 9, and 10 as shown in Figure 57. If the user depresses PFK9, the message "L.P. NEW CENTER POINT" is displayed. The user may respond by light-penning any desired point in the display. Now the program displays the man-model and the crew station as if looking along the point light-penned. The perspective of the display is initialized as if the viewing distance is 30 feet away from the screen. This distance may be increased in increments of 10 feet by repeatedly depressing PFK1, or decreased (closer to the screen) in increments of 10 feet by depressing PFK3. This distance increment may be redefined by selecting PFK4, for a 1 foot increment; PFK5, for a 10 feet increment; or PFK6, for a 100 feet increment. However, the lower and upper limits for the effective viewing distance are 10 feet and 1,000 feet respectively.

PFK9 must be depressed to select another view point.

PFK2 must be depressed to terminate the CHANGE PERSPECTIVE function and to return to the main program, resetting all PFKs to the original definition.

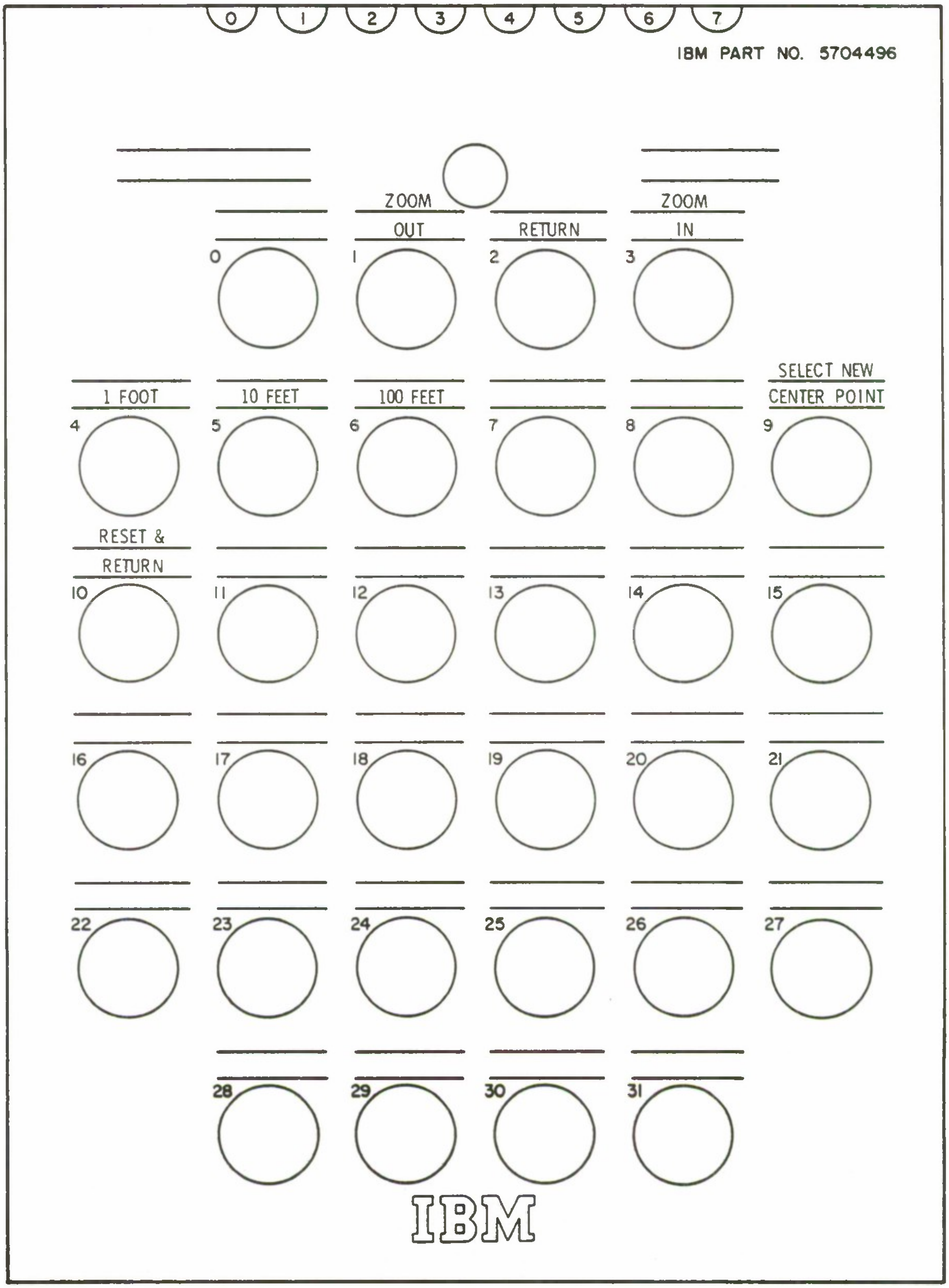


Figure 57. PFK's for Change Perspective Function.

PFK10 terminates the CHANGE PERSPECTIVE function, resetting the display and PFK definitions to their original positions.

Example: To view the display with respect to the left eye of the man-model, first depress PFK22. Then the PFKs 1, 2, 3, 4, 5, 6, 9, and 10 light up and the message "VIEW ADJUST" is displayed along with the man-model and crew station. Depress PFK9 and respond to the prompting message on the screen "L.P. NEW CENTER POINT" by light-penning the left eye of the man-model. The new display will be along a line with the same horizontal and vertical coordinates as the left eye of the man-model.

2.2.19 RESET SLUMPED POSTURE Function (PFK23)

The RESET SLUMPED POSTURE function resets the transformation angles of the man-model so that it assumes a slumped posture, as shown in Figure 58. The "slumped posture" is a posture for sitting erect in a seat with 13 degree back angle and a 6 degree seat pan angle. If other postures are desired, the skeletal-link angles have to be changed by the method specified in Paragraph 2.2.14, the DISPLAY TABLE function and the RESET PROGRAMMED POSTURE function as described in Paragraph 2.2.21. This function is commonly used to get back to a starting posture after a reach analysis or a modification of joint angles as described in Paragraph 2.2.14. The SLUMPED POSTURE is also the default posture of the man-model.

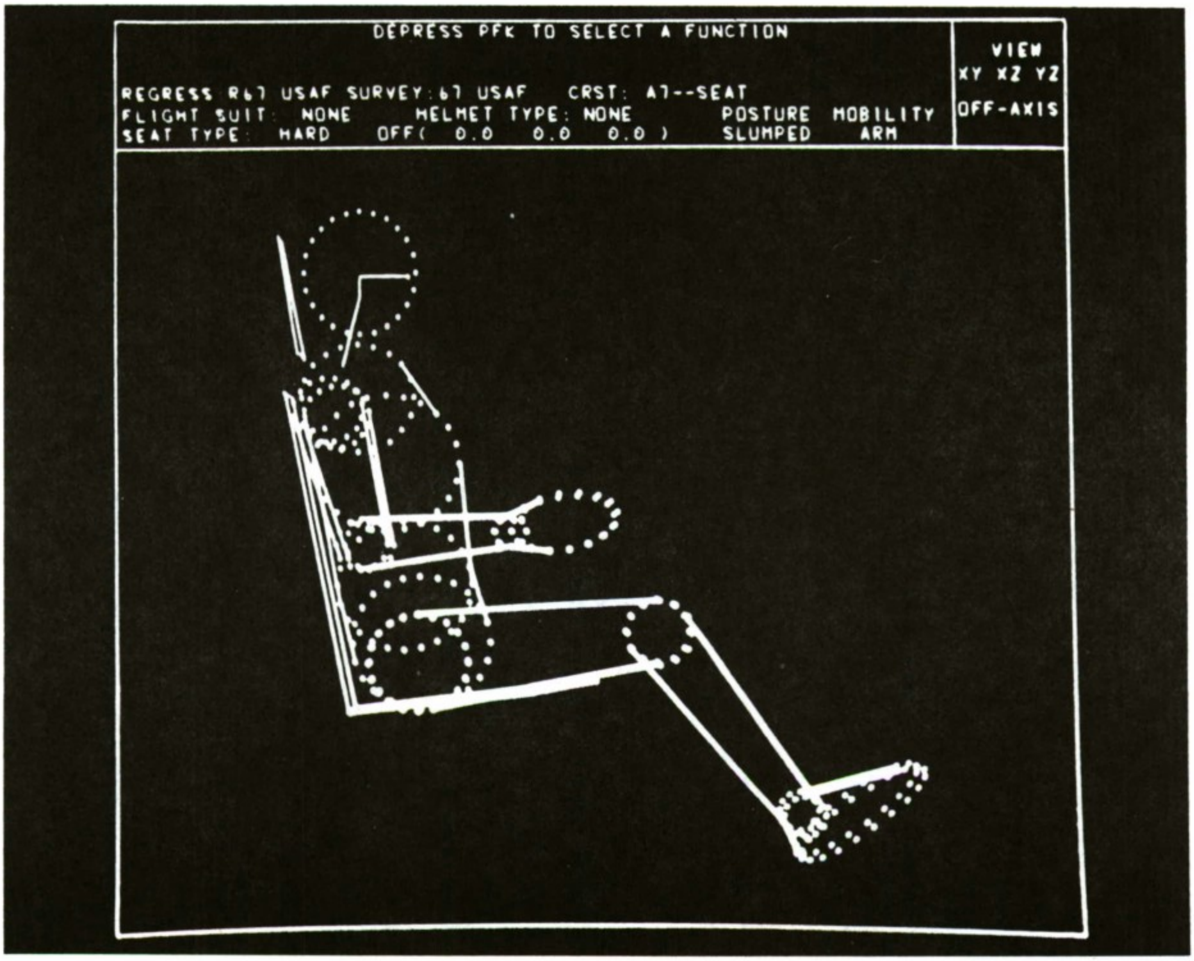


Figure 58. RESET SLUMPED Posture Function.

2.2.20 RESET ERECT POSTURE Function (PFK24)

The RESET ERECT POSTURE function resets the transformation angles of the man-model so that it assumes the standard erect posture as shown in Figure 59.

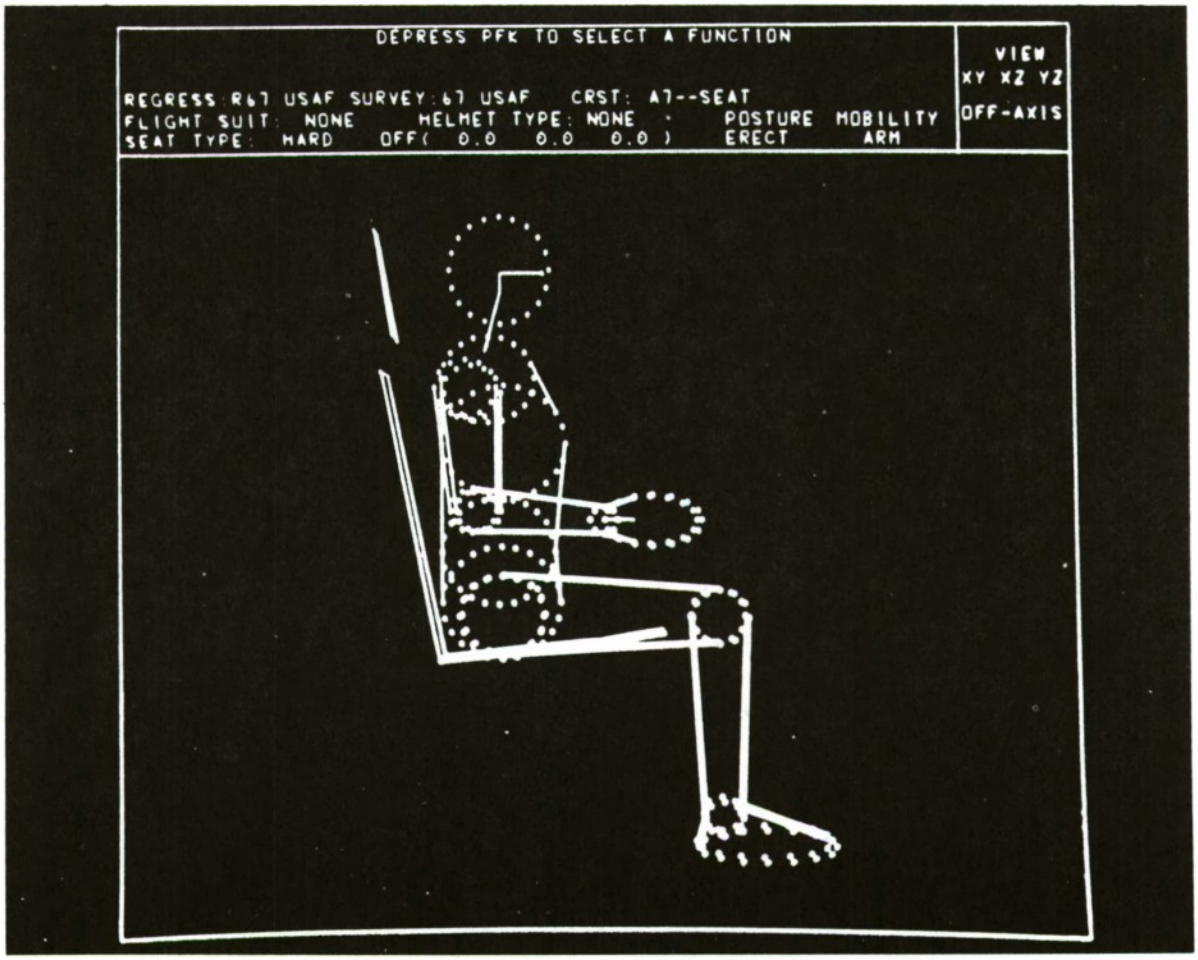


Figure 59. RESET ERECT POSTURE Function.

2.2.21 RESET PROGRAMMED POSTURE Function (PFK25)

The RESET PROGRAMMED POSTURE function resets the transformation angles of the man-model so that it assumes the "Programmed Posture". The "Programmed Posture" is any posture the user desires, which can be achieved by modifying the transformation angles using the DISPLAY TABLE function (see Paragraph 2.2.14). After all changes are made, the new posture of the man-model can be redisplayed at any time by depressing PFK25 (see Figure 60).

When the program CBM05 is initialized, the angles for the SLUMPED POSTURE are automatically entered into this PROGRAMMED POSTURE storage area, so initially pressing the PFK25 merely recalls the SLUMPED POSTURE. However, anytime the user changes any one or more angles in the link system Display Table, the changed angles are automatically entered into the PROGRAMMED POSTURE storage area. This function may be thought of as a "redisplay" of the last change to the Display Table (see Paragraph 2.2.14).

The angles changed by this function are not stored permanently. Therefore, everytime a new man-model is defined the angles for PROGRAMMED POSTURE must be redefined.

This function may be used to define a working posture to the user's own specification. Normally, a pilot sits with upper-back and head well forward, causing the eye position to be lowered. Since one posture will not serve all applications, this function allows the user to define and recall any posture.

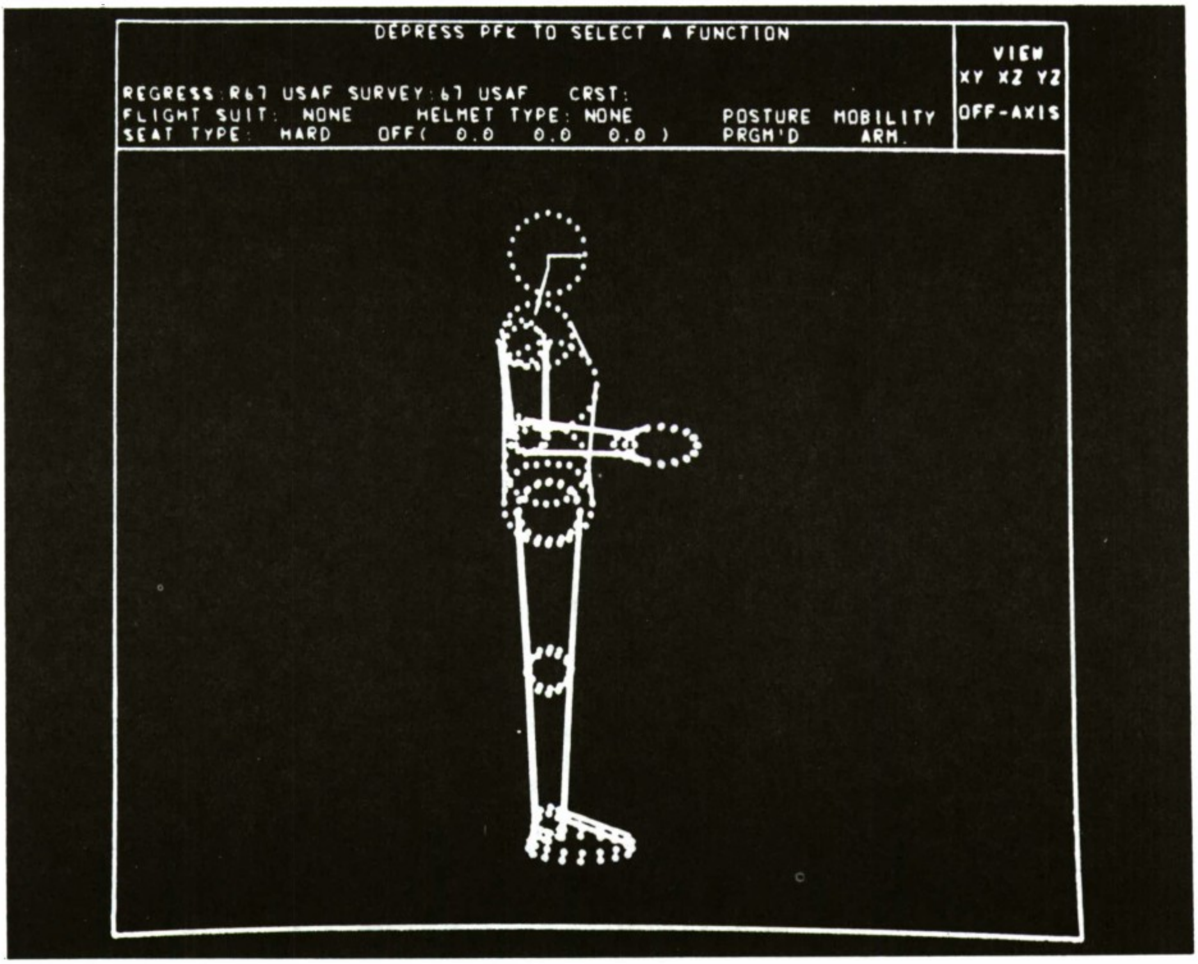


Figure 60. RESET PROGRAMMED POSTURE Function.

2.2.22 INCREMENT ROLL, PITCH, AND YAW ANGLE Function (PFK26)

The INCREMENT ROLL, PITCH AND YAW ANGLE function allows the user to enter a set of roll, pitch and yaw angle increments by which the man-model and crew station are rotated; and a maximum number of iterations desired before the display resets to roll, pitch and yaw angle values of 0.0 degrees. It is similar to a series of "CHANGE VIEW" function calls described in Paragraph 2.2.1.

This feature allows the user to rapidly rotate the model through a series of discrete steps without taking the time to enter new roll, pitch, and yaw angles using the CHANGE VIEW function. In the default case built into the program, the display assumes a side view with the first selection of PFK26 and on each depression of PFK26 the displayed image rotates -15 degrees in pitch (nose up) and +15 degrees in yaw (left) for six discrete steps, ending with a top view of the displayed crew station. The next depression of PFK26 resets the display to the original side view. The user may pause after any step to make a plot, or select other functions.

The preprogrammed example uses six discrete rotational increments of 0 degrees, -15 degrees, and, +15 degrees for the roll, pitch, and yaw angles. The user may redefine the number of increments or the roll, pitch, and yaw increments in the following manner.

First set State Switch 10 "ON" as described in Paragraph 2.2.24. Then depress PFK26 and respond to message "ENTER ROLL ANGLE" by entering the ROLL increment angle in degrees through the ANKB. Respond to subsequent messages to enter PITCH and YAW angles the same way. The message "ENTER MAX. NO. ITERATIONS" then appears in the Prompting Area of the

CRT. The user must then type the number of steps the program should take to reset the man-model from the ANKB followed by ALT-CODE/5 sequence. If the user wishes to change the Roll, Pitch, and Yaw angles or the number of iterations again, the State Switch 10 must once again be set "ON" and PFK26 depressed as above.

2.2.23 SEAT ADJUST Function (PFK27)

The SEAT ADJUST function allows the user to off-set the man-model and his seat, if any, with respect to the displayed crew station. This function cannot be activated unless a crew station is displayed on the CRT screen. A seat may or may not be preset at the user's option. The default values of the coordinates for this function are X=0, Y=0, and Z=0. After depressing PFK27, the user is prompted to enter the X coordinate off-set. The value in inches is typed using the ANKB and is entered by performing the ALT-CODE/5 sequence as shown in Figure 61. If the default value (0 inch) is to be retained, simply perform the ALT-CODE/5 sequence. The program then prompts the user to enter the Y and Z-coordinates in that order. The user must enter them the same way the X-coordinate is entered. The new coordinates will be displayed in the Information Area. Since the seat may be "adjusted" in three dimensions, this provides a method for placing the man-model (and seat) in different stations in a multi-operator crew station.

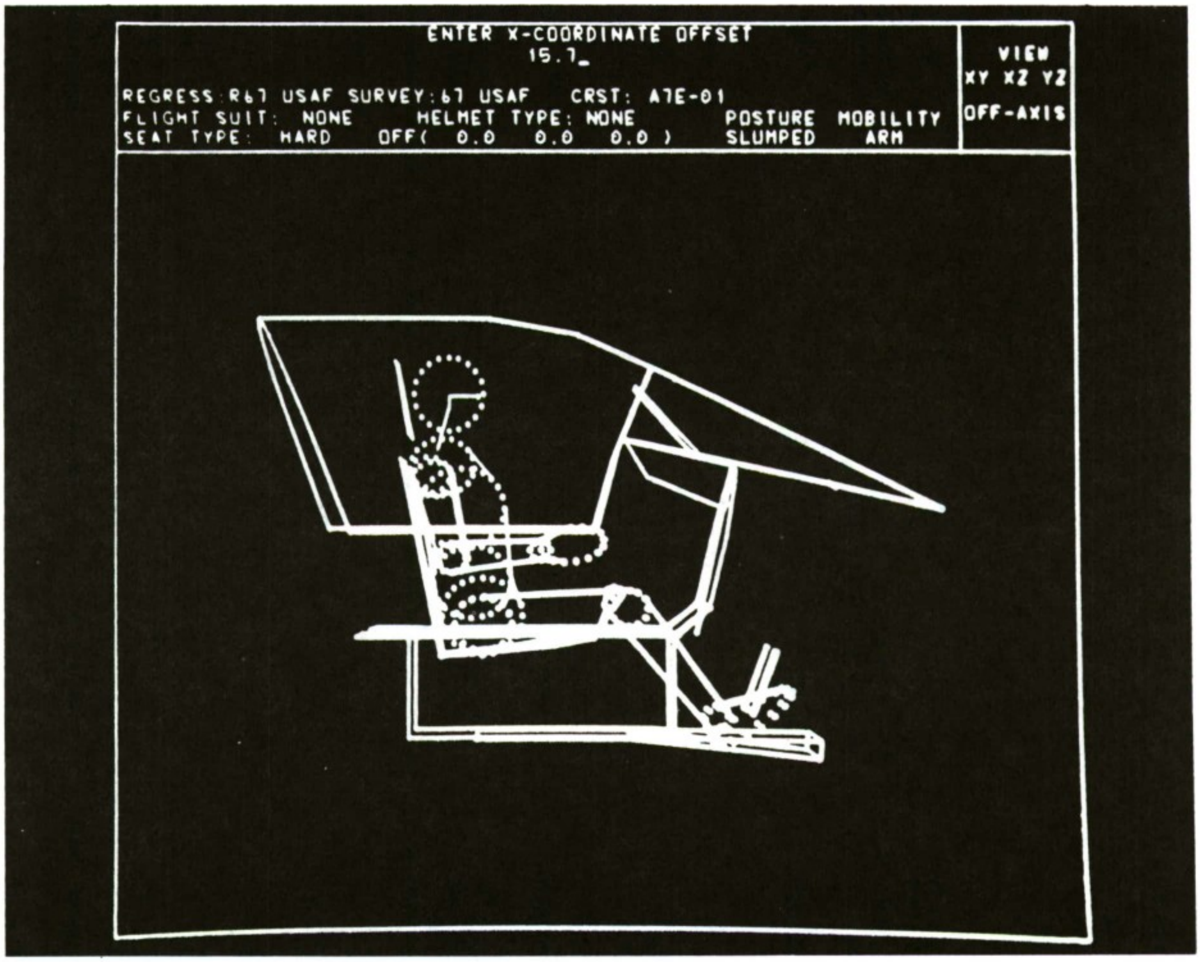


Figure 61. SEAT ADJUST Function Enter X Coordinate Offset in Inches.

2.2.24 ZOOM Function (PFK28)

The ZOOM function allows the user to "Zoom-in" on a user defined portion of the COMBIMAN Display Area. To activate the ZOOM function depress PFK28. The message "DEFINE ZOOM WINDOW" momentarily appears in the Prompting Area of the CRT. Next, a matrix of dots at 0.5 inch intervals cover the COMBIMAN Display Area and a message "L.P. LOWER LEFT CORNER" appear in the Prompting Area of the CRT as shown in Figure 62.

To cancel the ZOOM function at this point, simply perform the ALT-CODE/5 sequence and the program returns to the main routine. Otherwise light pen a dot to designate the lower left hand corner of the proposed zoom window. Now the program displays the limiting left and bottom lines of the window, and erases all dots below the horizontal line and left of the vertical line. Also the message "L.P. UPPPER RIGHT CORNER" appears in the Prompting Area of the screen as shown in Figure 63. The user may enter the ALT-CODE/5 sequence to register the upper right corner of the Display Area as the upper right corner of the zoom window or may light pen a dot to define the upper right corner of the zoom window. Now all the dots are removed and the completed zoom window boundaries are displayed as shown in Figure 64. The display is then regenerated with the information within the defined zoom window filling the entire Display Area of the CRT as shown in Figure 65.

The message "END ZOOM? ENTER Y/N" then appears in the Promtping Area of the CRT. The user now has the option to zoom-in further on the current display by answering "N" or "NO" using the ANKB, or to end the ZOOM function by depressing the ALT-CODE/5 sequence. Note that "Y" or "YES" is the default for the "END ZOOM? ENTER Y/N" message. When the ZOOM function is ended, control returns to the main routine, however, the

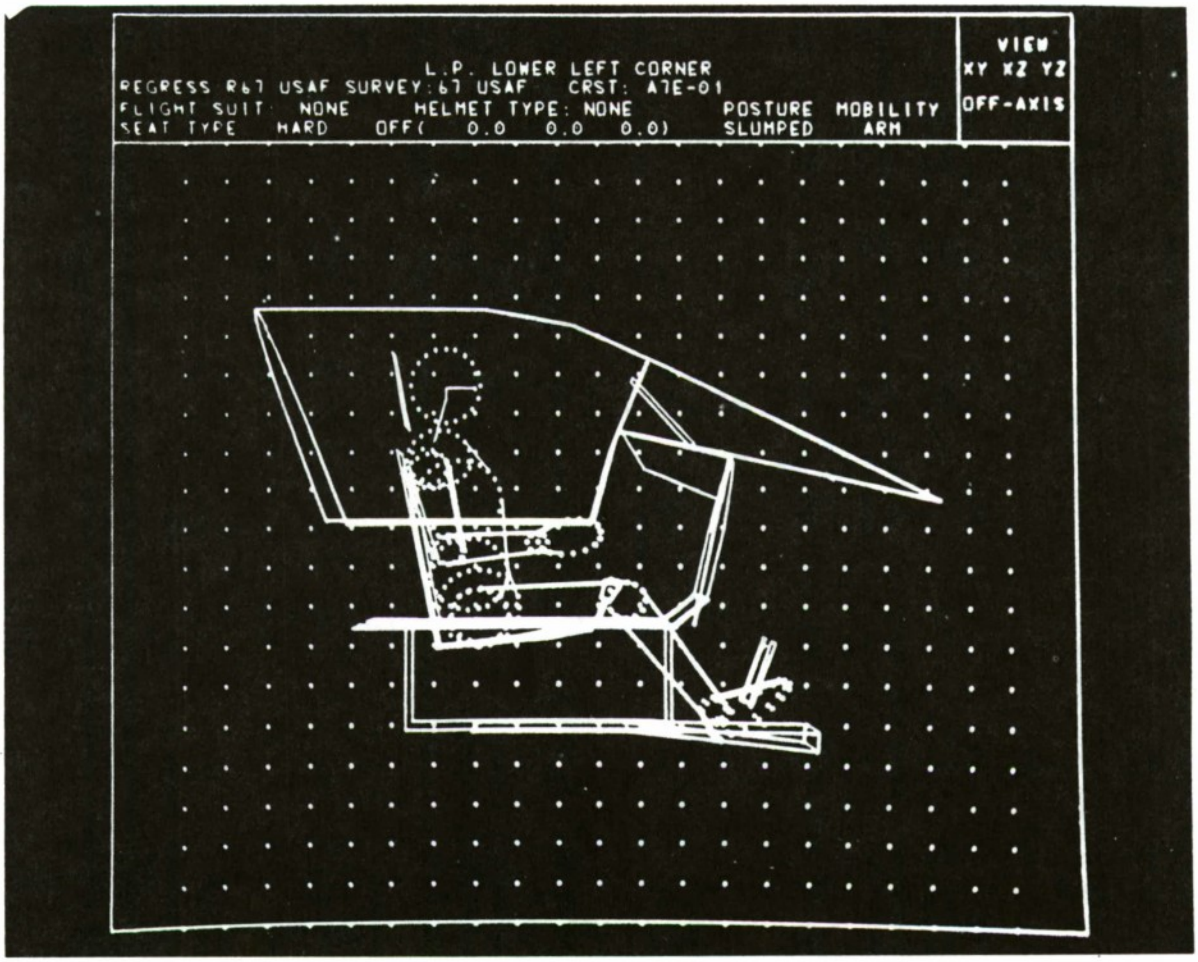


Figure 62. Define ZOOM Window. Step 1 - Light Pen Lower Left-Hand Corner of the ZOOM Window.

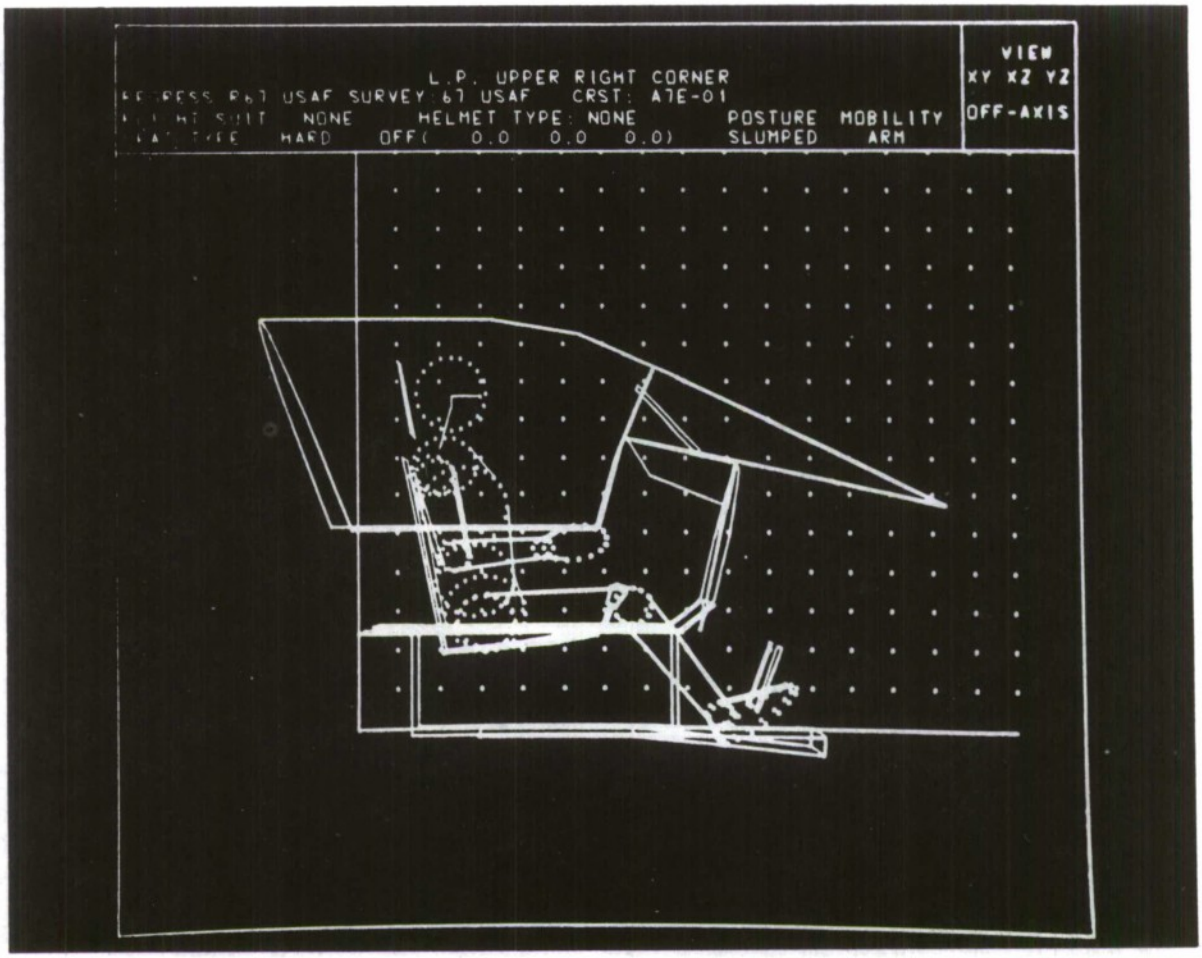


Figure 63. Define ZOOM Window. Step 2 - Light Pen Upper Right Corner of ZOOM Window.

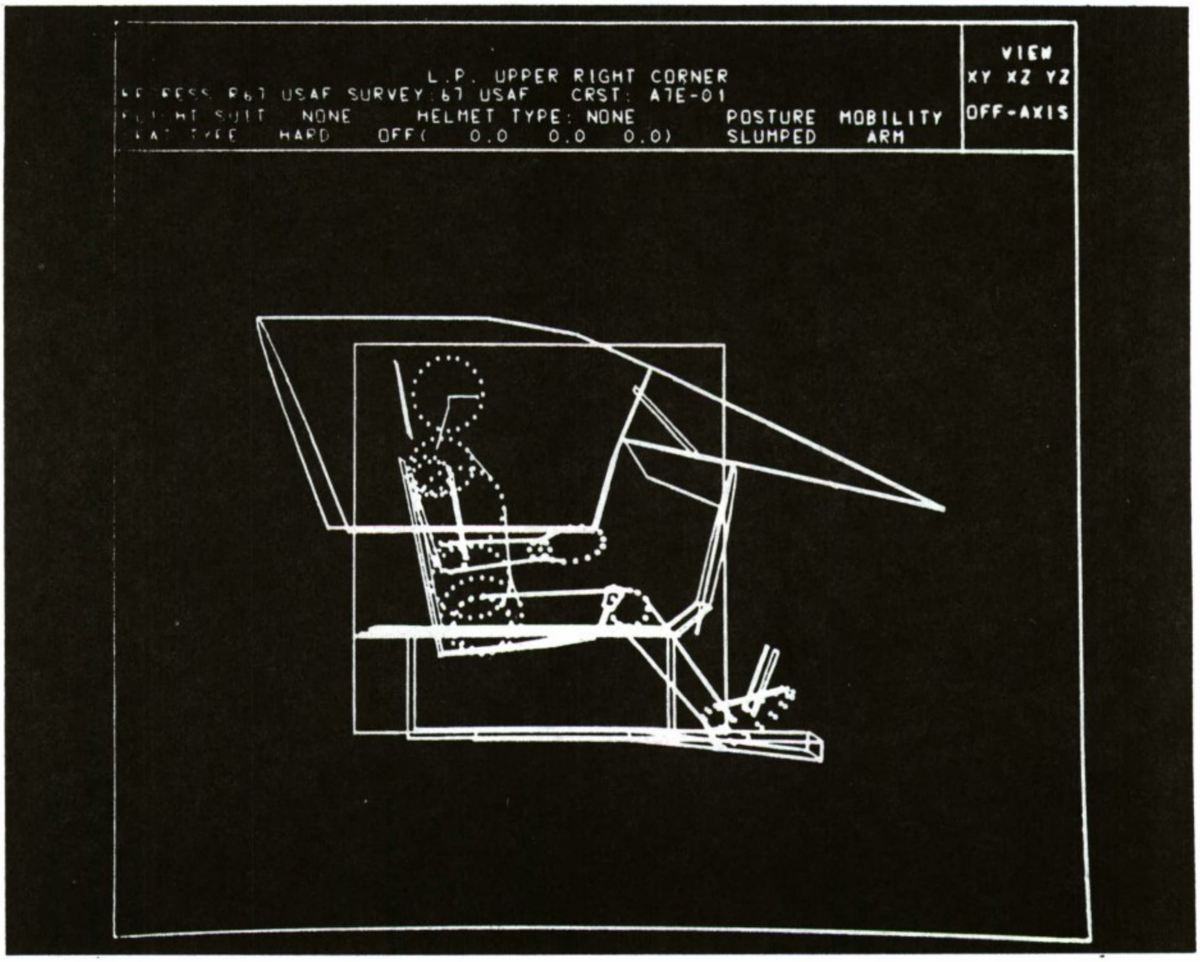


Figure 64. The Fully Defined ZOOM Window.

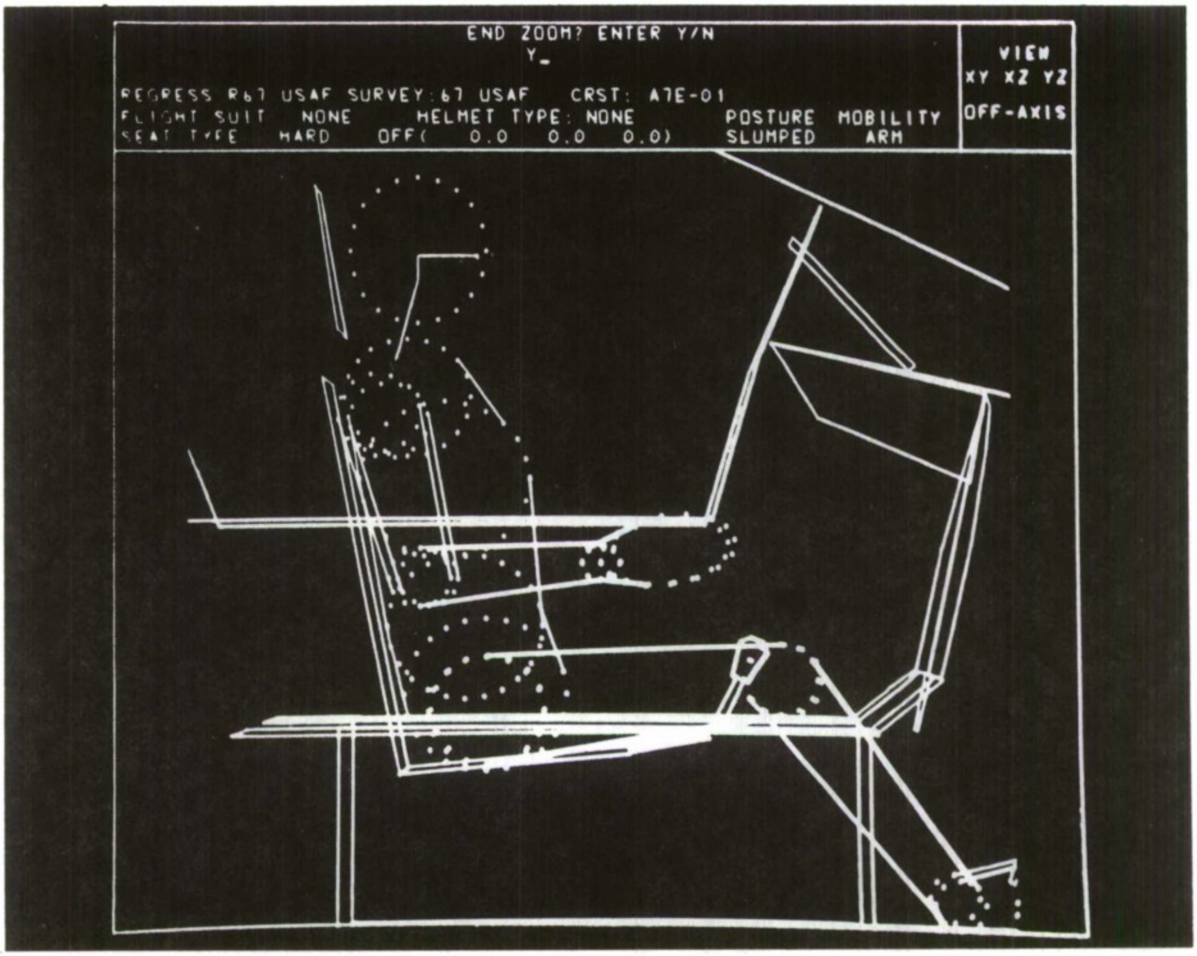


Figure 65. The "ZOOMED" Display. Choose Option to Continue or to End ZOOM on the "ZOOMED" Display.

display will remain in the zoom state until execution of another function causes regeneration of the display. Note that in order to return the display to the normal scaling and perspective at the termination of the ZOOM function, State Switch 21 must be set "ON", prior to depressing PFK28 to execute the ZOOM function.

When the user answers "N" or "NO" to the prompting message, "END ZOOM? ENTER Y/N" the message "DEFINE ZOOM WINDOW" is displayed. The user then defines a new zoom window on the already zoomed-in display. The ZOOM process continues until an ALT-CODE/5 sequence is detected for the lower left corner of the zoom window, or a response other than "N" or "NO" is entered upon completion of a requested ZOOM.

2.2.25 STATE SWITCH Function (PFK29)

The STATE SWITCH function allows the user to specify the state in which to run the program CBM05. Table 4 shows the various state switches available and the meanings of their states.

When this function is selected by depressing PFK29, the message "ENTER SWITCH NUMBER" is displayed. The user must enter the switch number from the ANKB followed by the ALT-CODE/5 sequence. Then the message "ENTER ON OR OFF" is displayed. The user must respond "ON" or "OFF" from the ANKB to invoke the state detailed in Table 4.

When switch 16 is chosen, and is set "ON", the message "ENTER ENFLESHMENT DENSITY CODE" is displayed. The user enters any number from 1 to 4 for increased enfleshment point density, any negative value for decreased enfleshment point density, and 0 for normal enfleshment from the ANKB and follows it by ALT-CODE/5 sequence. The man-model is displayed with the new enfleshment density. If switch 16 is set "OFF", the default value of "0" is chosen and the man-model is displayed with the normal enfleshment density. The man-model display with enfleshment density code "4" is shown in Figure 66.

TABLE 4

PROGRAM CBM05 USER ACTIVATED STATE SWITCHES

SWITCH NUMBER	IF ON	IF OFF
2	Prints crew station data.	Does not print crew station data-
3	The entire COMBIMAN link system is displayed.	Only the neck, head, and eye links are displayed
4	Prints 12 independent anthropometric dimension values on unit 6.	No printed output.
5	No enfleshment on man-model. (Link system only.)	Enfleshed man-model is displayed.
6	Print surface dimensions and computed internal link lengths. (As in Figures 67 and 68.)	Suppress printing surface and link length data.
10	Reset default conditions when PFK26 activated for roll, pitch, and yaw angles.	Use default conditions for PFK26.
16	Allows to change enfleshment density code for man-model.	Default value for enfleshment density code '0' is assumed.
20	Prints coordinate data of visibility plot as in Figure 33.	No printed output.
21	Zoomed display does not stay.	Zoomed display stays.
22	12 Anthropometric dimensions input from cards (COMBIMAN.SMPLANTH).	12 Anthropometric dimensions cannot be input from cards.
72	Matrices (link) printed, as shown in Figure 69.	No printed output.

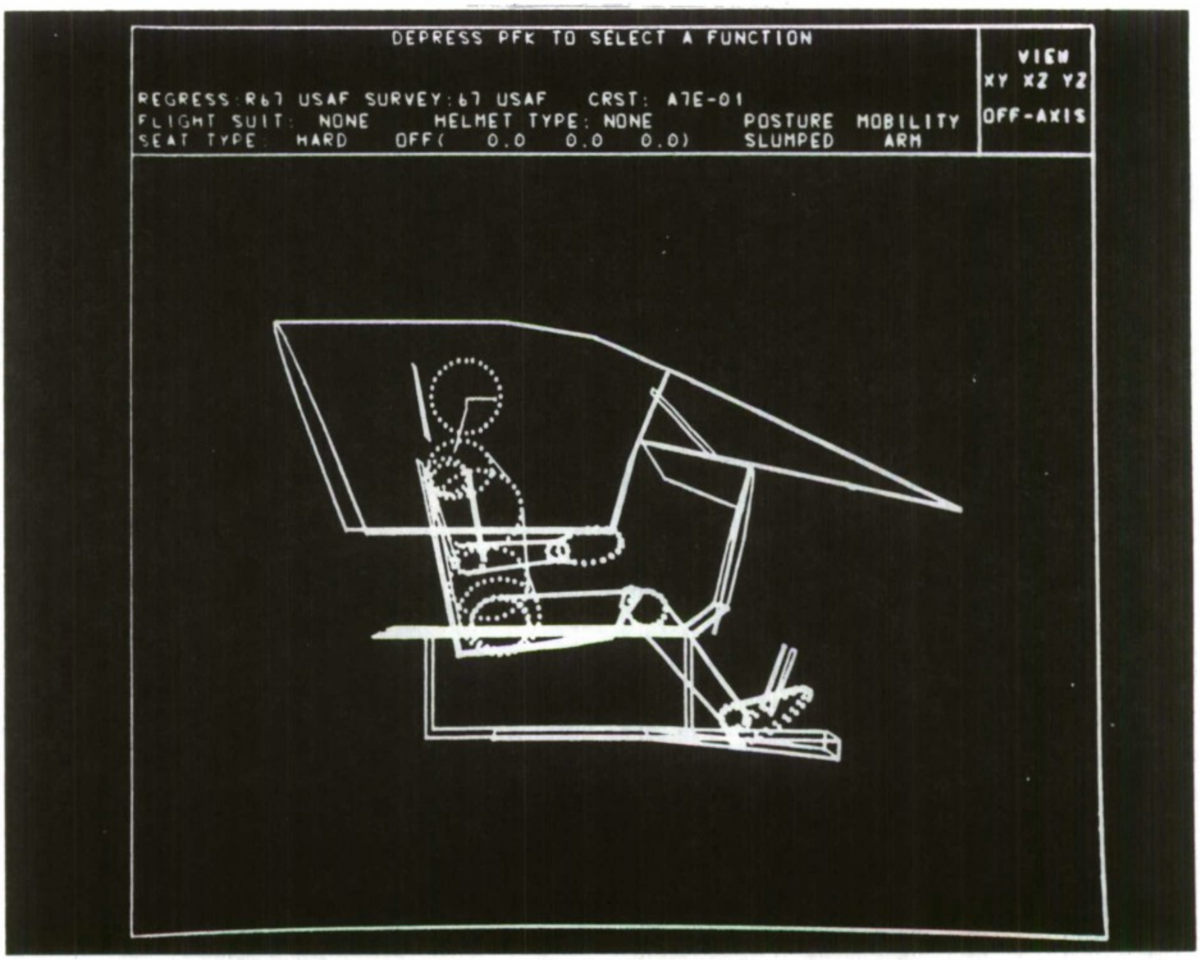


Figure 66. Man-Model with Enfleshment Density Code 4
(Default Enfleshment Density Code is 0).

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COMBIMAN LINK DATA

REFERENCED SURVEY OF REGRESSION EQUATIONS IS R67 USAF
REFERENCED SURVEY OF ANTHROPOMETRIC DIMENSIONS IS 67 USAF

NO.	LINK NAME	LENGTH	REF. ANTH. DIM.	A-LENGTH	A-OFFSET	B-LENGTH	B-OFFSET	C-LENGTH	C-OFFSET
0	SRP	0.0		0.0	0.0	0.0	0.0	0.0	0.0
1	SRP-MHIP	5.75	BUTTOCK-KNE LGTH	4.582	-0.980	7.413	0.0	4.582	0.652
2	STOMACH	5.18	ACROMION HGT/SIT	4.367	0.713	6.067	0.0	4.367	0.138
3	CHEST	9.47	SITTING HEIGHT	4.808	2.027	6.431	0.0	4.808	-0.395
4	LWR NECK	7.49	SITTING HEIGHT	3.611	0.467	8.008	0.0	3.611	-2.228
5	UPR NECK	5.21	SITTING HEIGHT	0.0	0.0	0.0	0.0	0.0	0.0
6	MID HEAD	1.40	SITTING HEIGHT	3.885	0.0	3.042	0.0	4.471	0.340
7	MH-MEYE	3.34	SITTING HEIGHT	0.0	0.0	0.0	0.0	0.0	0.0
8	MEYE-REY	1.25		0.0	0.0	0.0	0.0	0.0	0.0
9	MEYE-LEY	1.25		0.0	0.0	0.0	0.0	0.0	0.0
10	LN-MIDSS	3.23	SITTING HEIGHT	0.0	0.0	0.0	0.0	0.0	0.0
11	MSS-RSS	1.00		0.0	0.0	0.0	0.0	0.0	0.0
12	RSS-RSLD	8.26	BIACROMIAL BRDTH	0.0	0.0	0.0	0.0	0.0	0.0
13	RSLDR	0.0		2.305	0.0	2.304	0.0	2.074	-0.300
14	RUPARM	10.93	SHOULDR-ELB LGTH	1.729	0.553	1.729	0.0	1.729	-0.837
15	RLWARM	10.56	ELBOW-WRIST LGTH	1.100	0.0	1.100	0.0	1.100	0.0
16	RGRIPCTR	2.00	HAND LENGTH	2.005	0.0	0.540	0.0	3.760	1.760
17	RFRCH	4.69	HAND LENGTH	0.0	0.0	0.0	0.0	0.0	0.0
18	RFNGRTIP	7.52	HAND LENGTH	0.0	0.0	0.0	0.0	0.0	0.0
19	MSS-LSS	1.00		0.0	0.0	0.0	0.0	0.0	0.0
20	LSS-LSLD	8.26	BIACROMIAL BRDTH	0.0	0.0	0.0	0.0	0.0	0.0
21	LSLDR	0.0		2.305	0.0	2.304	0.0	2.074	-0.300
22	LUPARM	10.93	SHOULDR-ELB LGTH	1.729	0.553	1.729	0.0	1.729	-0.837
23	LLWRARM	10.56	ELBOW-WRIST LGTH	1.100	0.0	1.100	0.0	1.100	0.0
24	LGRIPCTR	2.00	HAND LENGTH	2.005	0.0	0.540	0.0	3.760	1.760
25	LFRCH	4.69	HAND LENGTH	0.0	0.0	0.0	0.0	0.0	0.0
26	LFNGRTIP	7.52	HAND LENGTH	0.0	0.0	0.0	0.0	0.0	0.0
27	MHIP-RHP	3.43	HIP BREADTH	3.240	-0.166	3.240	0.0	4.097	-0.118
28	RUPRLEG	17.02	BUTTOCK-KNE LGTH	2.156	0.0	2.156	-0.105	2.156	-0.105
29	RLWRLEG	16.15	KNEE HGT/SITTING	1.400	0.0	1.400	0.0	1.400	0.0
30	RNK-RKCH	2.21	KNEE HGT/SITTING	5.315	-3.306	1.921	0.0	1.277	0.0
31	MHIP-LHP	3.43	HIP BREADTH	3.240	-0.166	3.240	0.0	4.097	-0.118
32	LUPRLEG	17.02	BUTTOCK-KNE LGTH	2.156	0.0	2.156	-0.105	2.156	-0.105
33	LLWRLEG	16.15	KNEE HGT/SITTING	1.400	0.0	1.400	0.0	1.400	0.0
34	LNK-LKCH	2.21	KNEE HGT/SITTING	5.315	-3.306	1.921	0.0	1.277	0.0

Figure 67. Surface Dimensions and Internal Link Lengths Calculated by CBM05.

```
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                         COMBIMAN ANTHROPOMETRIC DATA

REFERENCED SURVEY OF REGRESSION EQUATIONS IS R67 USAF
REFERENCED SURVEY OF ANTHROPOMETRIC DIMENSIONS IS 67 USAF


-USER SUPPLIED INDEPNDNT VALUES-      -CNVRTD DFLT-
 VBL. NAME            VALUE   UNIT     VALUE   UNIT
---------------- -------- -----       -------- ----
SITTING HEIGHT       50 PCT             36.650  IN
WEIGHT               50 PCT            172.420  LB
-----COMPUTER CALC. DEP. VALUES-----
NO.     VBL. NAME           VALUE   UNIT
--- ----------------     -------- ----
  1 WEIGHT                172.420  LB
  2 SITTING HEIGHT         36.650  IN
  3 ACROMION HGT/SIT       24.012  IN
  4 KNEE HGT/SITTING       21.940  IN
  5 BUTTOCK-KNE LGTH       23.771  IN
  6 SHOULDR-ELB LGTH       14.143  IN
  7 BIACROMIAL BRDTH       16.015  IN
  8 HIP BREADTH            13.851  IN
  9 CHEST DEPTH             9.625  IN
 10 FOOT LENGTH            10.631  IN
 11 HAND LENGTH             7.520  IN
 12 ELBOW-WRIST LGTH       11.802  IN
```

Figure 68. Printed Output of the Two Selected Independent Variable Values Calculated by CBM05.

```
STOMACH , HEIRARCHY= 3

---                      ---   ---                     ---   ---                     ---
I   0.94   0.0    -0.35  I     I    0.59   0.0    0.81 I     I   0.27   0.0    -0.96 I
I   0.0    1.00    0.0   I  =  I    0.0    1.00   0.0  I  X  I   0.0    1.00    0.0  I
I   0.35   0.0     0.94  I     I   -0.81   0.0    0.59 I     I   0.96   0.0     0.27 I
---                      ---   ---                     ---   ---                     ---

---        ---   ---                       ---   ---          ---   ---         ---
I   2.71   I     I    0.94   0.0   -0.35   I     I   0.0     I     I   4.41    I
I   0.0    I  =  I    0.0    1.00   0.0    I  X  I   0.0     I  +  I   0.0     I
I   7.78   I     I    0.35   0.0    0.94   I     I   4.85    I     I   3.24    I
---        ---   ---                       ---   ---          ---   ---         ---


STOMACH , HEIRARCHY= 3     JOINT CENTER ROTATED BY ROLL, PITCH, YAW

---         ---   ---                       ---   ---         ---
I    0.0    I     I    0.0    1.00   0.0    I     I   2.71    I
I   -2.71   I  =  I   -1.00   0.0    0.0    I  X  I   0.0     I
I    7.78   I     I    0.0    0.0    1.00   I     I   7.78    I
---         ---   ---                       ---   ---         ---
                          5.46  -3.04     7.96  -5.46    -3.04   7.96     0.0   -3.04
                         11.84   0.0     -3.04   4.08     1.35  -3.04    11.71  -1.35
                         -3.04   4.20     1.35  -3.04     4.20  -1.35    -3.04  11.71
                          2.63  -3.04    11.35  -2.63    -3.04   4.57     2.63  -3.04
                          4.57  -2.63    -3.04  11.35     3.76  -3.04    10.77  -3.76
                         -3.04   5.14     3.76  -3.04     5.14  -3.76    -3.04  10.77
                          4.65  -3.04    10.00  -4.65    -3.04   5.92     4.65  -3.04
                          5.92  -4.65    -3.04  10.00     5.25  -3.04     9.05  -5.25
                         -3.04   6.86     5.25  -3.04     6.86  -5.25    -3.04   9.05
```

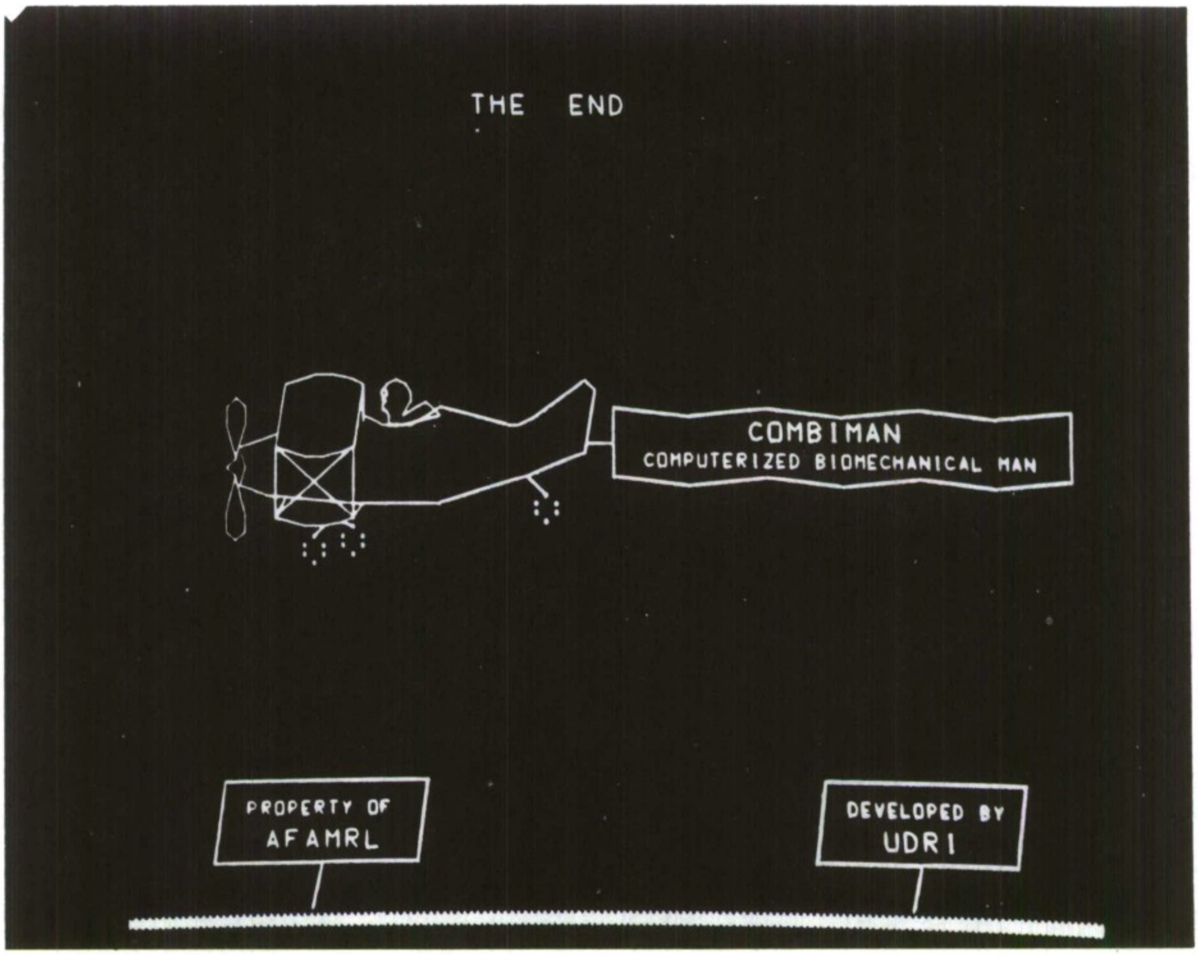
Figure 69. Transformation Equation Developed for Positioning Stomach Link (Set State Switch 72 ON).

2.2.26 RESTART PROGRAM Function (PFK30)

The RESTART PROGRAM function allows the user to start program CBM05 over again. When this function is evoked, all State Switches, Anthropometric dimensions, and crew station data must be redefined. Note that any modifications made to link lengths, link angles, or crew station definitions before depressing PFK30 are lost. The message "CBM003I PROGRAM RE-START" is written on output unit 8.

2.2.27 END PROGRAM Function (PFK31)

The END PROGRAM function displays the COMBIMAN Banner and terminates the program CBM05, prints data on output unit 6 and messages on output unit 8.



END OF COMBIMAN PROGRAM.

2.3 EXECUTING THE JOB

This sequence is intended to assist the user to load the program CBM05, to specify processing, to handle error procedures, to obtain output, and to end the program run. It will not describe data formats and program functions because they are described in detail in Paragraph 2.2 of this section.

2.3.1 Loading the Program CBM05

The Job Control Cards to load the program CBM05 are shown in Figure 70. The program begins execution of CBM05 by displaying the COMBIMAN banner. When the user depresses PFK0, "enabled" PFKs light up and the message "DEPRESS PFK4 TO SELECT ANTH DATA" is displayed. Now the user can begin processing the man-model by depressing PFK4 to select anthropometry. The processing performed by enabled or lighted function keys are explained in Paragraph 2.2.

Anthropometric and crew station geometry data necessary to execute the interactive program CBM05 are created and maintained by the programs CBMAM, CBMCM, and CBMVM described in Sections 4, 5, and 6. The user may select data from these data bases or may modify them to suit the situation. All interactions with the program are done through the Program Function Keyboard, the Alphanumeric Keyboard, and the Light Pen.

2.3.2 Error Procedures

The program CBM05 performs some preliminary error checking on the data supplied by the user. The majority of checking is performed for data values which are outside the limits built into the program or the wrong type (i.e. alpha or

```
//COMBIMAN JOB PEG
//JOBLIB DD DSN=COMBIMAN.LOADLIB,DISP=SHR
//STEP1    EXEC PGM=CBM05,REGION=550K
//**********************************************************************
//*                                                                    *
//*        THE INITIALIZATION, ANTHROPOMETRIC, CREW STATION,           *
//*        AND VISIBILITY MEMBER DATA SETS ARE ASSUMED TO BE           *
//*        ON DISK AND CATALOGED.                                      *
//*        THEIR DCB PARAMETERS ARE SUPPLIED ON COMMENT CARDS          *
//*                                                                    *
//**********************************************************************
//SYSUT1   DD SPACE=(TRK,(40)),UNIT=SYSDA
//*                WORKSPACE FOR GOULD PLOTTER                         *
//SYSPOUT  DD SYSOUT=A
//*                MESSAGE UNIT FOR GOULD PLOTTER                      *
//SYSPLOT  DD UNIT=GOULD
//*                ONLINE GOULD 5000 PLOTTER                           *
//FT01F001 DD DSN=COMBIMAN.INITDATA,DISP=SHR
//*           DCB=(RECFM=VBS,LRECL=150,BLKSIZE=3200)                   *
//*           SPACE=(3200,(6,1),RLSE)                                  *
//FT02F001 DD DSN=COMBIMAN.ANTHDATA,DISP=SHR
//*           DCB=(RECFM=F,LRECL=248,BLKSIZE=248)                      *
//FT03F001 DD DSN=COMBIMAN.CRSTDATA,DISP=SHR
//*           DCB=(RECFM=F,LRECL=368,BLKSIZE=368)                      *
//FT05F001 DD DSN=COMBIMAN.SMPLANTH,DISP=SHR
//*                CARD IMAGE                                          *
//FT06F001 DD SYSOUT=A
//FT07F001 DD SYSOUT=B
//FT08F001 DD DISP=(,PASS),SPACE=(1210,(50,20)),UNIT=SYSDA,
//            DCB=(LRECL=121,RECFM=FB,BLKSIZE=1210)
//*                TEMPORARY DATA SET                                  *
//FT09F001 DD DSN=COMBIMAN.VISBDATA,DISP=SHR
//*           DCB=(RECFM=F,LRECL=240,BLKSIZE=240)                      *
//FT10F001 DD UNIT=2250
//*                IBM DISPLAY UNIT 2250-3                             *
//FT11F001 DD DSN=COMBIMAN.PLOTDATA,DISP=SHR
//*           DCB=(RECFM=FB,LRECL=80,BLKSIZE=800)                      *
//*                OFF-LINE PLOT DATA SET                              *
//SYSABEND DD SYSOUT=A
//STEP2    EXEC PGM=IEBGENER,COND=EVEN
//*                PRINTS MESSAGES                                     *
//SYSPRINT DD DUMMY
//SYSIN    DD DUMMY
//SYSUT1   DD DSN=*.STEP1.FT08F001,DISP=(OLD,DELETE)
//SYSUT2   DD SYSOUT=A,DCB=(BLKSIZE=121,RECFM=FA)
//
//
```

Figure 70. JOB CONTROL CARDS to Execute CBM05.

numeric). For example: State Switch numbers must be between 1 and 72; the maximum number of panels for any crew station configuration to be displayed cannot exceed 250; and all anthropometric dimensions entered must be positive values. When the user light-pens or types in values which are out of range, the program prompts the user to retry the entry. Numerical values can be typed with or without a decimal point, at the user's option.

Example 1. Enter State Switch number "3".

This can be done in any one of the following ways.
(a) Type "3" and depress ALT-CODE/5.
(b) Type "3." and depress ALT-CODE/5.
(c) Type "3.0" and depress ALT-CODE/5.

If the program expects a whole number, decimal values are rounded off to the nearest Integer. Example 3.4 and 2.7 are rounded off to 3.

If the program expects two decimal places, the input number is rounded off accordingly.

Example 2. Change a value in the link table from 10.50 to 11.32.

Light-pen 10.50, then Type "11.32" and depress ALT-CODE/5.

Typing "11.319" or "11.3215" and depressing ALT-CODE/5 has the same effect as entering 11.32.

If a Program Function Key is depressed the corresponding function as described in Paragraph 2.2 is enabled. However, if a key is pressed erroneously, the following procedure may be followed to return to the main program.

For Program Function Keys 0, 1, 2, 3, 6, 7, 8, 11, 14, 16, 18, 28, and 29 depress ALT-CODE/5 to cancel the selected function.

With Program Function Keys 4, 12, 13, and 27, the function must be executed.

For Program Function Key 5, light-pen "*NONE*" in the display to cancel the execution of the RETRIEVE CREW STATION function.

For Program Function Keys 9, 15, 23, 24, 25, 26, 30, and 31, the functions are executed as soon as the PFKs are depressed.

For Program Function Key 22, depress the temporarily defined PFK2 or PFK10 to return to the main graphics routine.

2.3.3 Ending the Program CBM05

There are three ways to end program CBM05. The primary method for terminating the program is through CBM05, by depressing the END PROGRAM function key PFK31. This option can be exercised only when the message "DEPRESS PFK TO SELECT A FUNCTION" appears in the Prompting Area of the CRT. Another method to terminate execution of the program is to use the CANCEL key on the IBM 2250 Alphanumeric Keyboard. When CANCEL key and ALT CODE key are depressed together, the three options shown in Figure 71 are displayed.

Light-penning the "TERMINATE" option terminates the program without producing a memory dump of program CBM05. The "DUMP" option terminates the program and produces a full storage dump. The "RESUME" resumes the execution of program CBM05 as though the CANCEL key had not been used. This option is provided by the system and can be used at any time.

The third option is to cancel the JOB from the computer operator's console. This is a system dependent option.

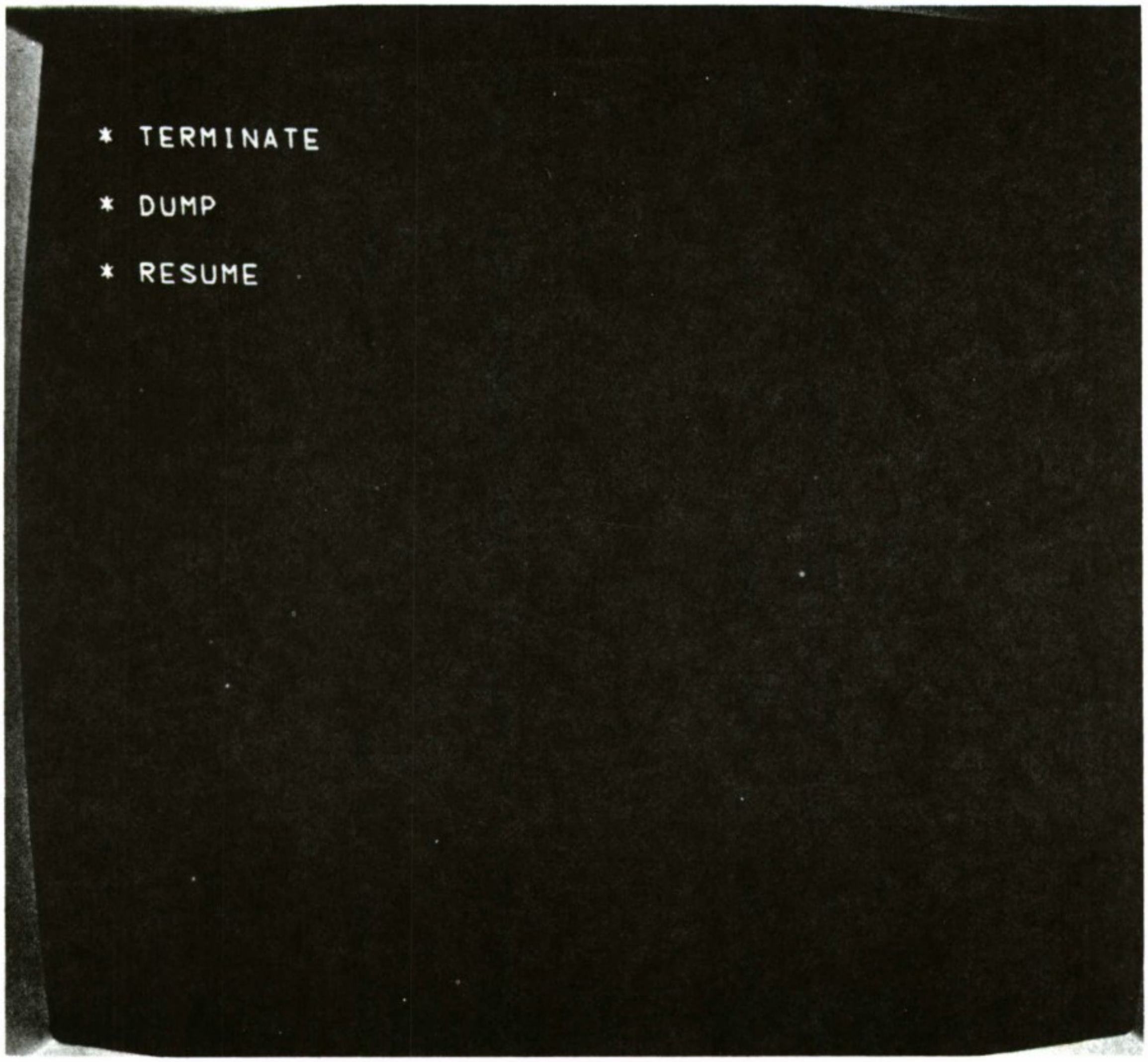


Figure 71. Options Displayed on Depressing ALT CODE and CANCEL Keys Together.

2.4 PROGRAM MESSAGES-INFORMATION AND ERROR TYPES

The program CBM05 prints out both information and action oriented messages. The message format is as follows:

CBM0nni   <u>Message Text</u>

where:

CBM	identifies the message and indicates that the message originates from the COMBIMAN system,
0	identifies the message and indicates that the message originates from the program CBM05,
nn	is the message number,
i	is the action code (I=information, A=action to be performed), and
Message Text	is the message text.

The messages are as follows:

CBM001I COMBIMAN V5, DATE=MM/DD/YY, TIME=hh.mm.ss.

	Issued By:	CBMINT.
	Reason:	Program CBM05 started at this date and time.
	System Action:	Execution continues.
	User Action:	None.

CMB002I PROGRAM END.

	Issued By:	CBMRTS.
	Reason:	The user requested the END PROGRAM function.
	System Action:	The program ended as requested.
	User Action:	None.

CBM003I PROGRAM RESTART

	Issued By:	CBMRTS.
	Reason:	The user requested the RESTART PROGRAM function.
	System Action:	The program restarted as requested.
	User Action:	None.

CBM007I panel number.) panel name, TYPE=nn, nn VERTICES.

	Issued By:	CBMPNL or CBMCRW
	Reason:	The user defined a panel through the DESIGN PANEL function.
	or	
		The User requested the crew station data by setting state switch 2 ON.
	System Action:	The defined panel is accepted or the crew station data are printed.
	User Action:	None.

CBM009I SWITCH switchnumber ON/OFF

	Issued By:	CBMSSW.
	Reason:	The user requested a change in the execution of the program using the STATE SWITCH function.
	System Action:	Switch switchnumber is now either "ON" or "OFF."
	User Action:	None.

CBM010I IDENTIFIED objectname

Issued By: CBMIOI.

Reason: The user requested the IDENTIFY OBJECT function to identify an object displayed on the screen.

System Action: The system displays the name of the object, the coordinates of the distal-end point, and the internal "key" number.

User Action: None.

CBM011I OMITTED objectname

Issued By: CBMIOI.

Reason: The user requested that an object be removed from the display using the "OMIT OBJECT" function.

System Action: The light penned object is removed from the screen, and the name of the object, coordinates of the distal-end point, and the internal "key" number are displayed on the screen.

User Action: Record the internal "key" number in order to include the object in the display at a later time.

CBM012I INCLUDED objectname

Issued By: CBMIOI.

Reason: The user requested that an object be included back into the display using the INCLUDE OBJECT function.

System Action: The requested object is included back into the display.

User Action: None.

CBM014I Crew Station DATA FROM membername

Issued By: CBMCRW.

Reason: The user requested the retrieval of a crew station definition by the RETRIEVE CREW STATION funtion.

System Action: The requested crew station member is retrieved.

User Action: None.

CBM015I SURVEY DATA FROM membername

Issued By: CBMIN1.

Reason: The user requested membername Survey Data from the Anthropometric Data Base.

System Action: The requested survey data are retrieved.

User Action: None.

CBM016I VIEW=(roll, pitch, yaw), SCALE=factor, OFFSET=(x,y,z).

Issued By: CBMCVW.
Reason: The user requested a new off-axis view through the "CHANGE VIEW" function.
System Action: The display is rotated as specified.
User Action: None.

CBM018A INITIALIZATION DATA MISSING.

Issued By: CBMINT.
Reason: Initialization Data could not be found.
System Action: The program is terminated.
User Action: Check to see that the initialization data set has not been destroyed.

CBM019I PLOTS COMPLETED.

Issued By: CBMCP1.
Reason: The requested hard copy plot of the COMBIMAN display is finished.
System Action: Continue processing
User Action: None.

CBM022A TOO MANY PANELS/VERTICES.

Issued By: CBMCRW.
Reason: More panels were defined through the RETRIEVE CREW STATION function (PFK5) or the DESIGN PANEL function (PFK16) than could be handled at one time. The maximum number of panels that can be handled at one time is 250.
System Action: The panel being defined is ignored.
User Action: Delete a few panels by the DELETE PANEL function (PFK18) or delete a crew station using the RETRIEVE CREW STATION function before defining more panels.

CMB026I DELETE PANEL panelname.

Issued By: CBMDPL.
Reason: The user requested to delete panel panelname using the DELETE PANEL function.
System Action: The panel is deleted.
User Action: None.

CBM031A CREW STATION DATA BASE MISSING.

Issued By: CBMCRW.

Reason: Identification record of the file containing a crew station data is missing.

System Action: Displays similar message to CRT and returns control to main program.

User Action: Stop program, if crew stations are needed.

CBM033I REGRESSION VALUES FROM MEMBER membername.

Issued By: CBMIN1.

Reason: User entered a valid regression or type 0 anthropometric data base membername using light pen.

System Action: Data from the referenced member are read.

User Action: None.

CBM034A ANTHROPOMETRIC DATA BASE MISSING.

Issued By: CBMINT, CBMIN1.

Reason: The identification record of the file which contains anthropometric data is missing.

System Action: Displays similar message on CRT and returns control to main program.

User Action: Stop program; create anthropometric data base.

CBM035A VARIABLE NO. nn OF REGRESSION SURVEY membername HAS INVALID UNIT OF uu.

Issued By: CBMIN1.

Reason: The unit of measurement read in for the specified variable and survey was not either IN, CM, MM, LB, or KG.

System Action: Remainder of data for variable is read in.

User Action: Report condition to systems programmer.

CBM039I UNIT OF VARIABLE vblname HAS BEEN CHANGED TO uu.

Issued By: CBMIND, CBMDEP.

Reason: The user changed the default unit of measurement of the selected variable.

System Action: Flag the unit as being changed.

User Action: None.

CBM040A INVALID UNIT OF uu SPECIFIED FOR VARIABLE vblname.

Issued By: CBMIND, CBMDEP.

Reason: The variable in question was defined in the anthropometric survey as having a length or weight type of measurement. The unit specified by the user was not consistent with the original definition.

System Action: Change ignored.

User Action: Specify correct unit or keep default unit.

CBM041I INPUT VARABLES WILL BE IN PERCENTILES.

Issued By: CBMIND, CBMDEP.

Reason: User has indicated that values for anthropometric variables will be given as percentiles.

System Action: None.

User Action: None.

CBM042I INPUT VARIABLES WILL BE IN ABSOLUTE VALUES.

Issued By: CBMIND, CBMDEP.

Reason: User has indicated that values for anthropometric variables will be given in engineering units.

System Action: None.

User Action: None.

CBM043I USER CHOOSES TO INPUT nn DEPENDENT VARIABLES.

Issued By: CBMDEP.

Reason: User has depressed PFK12, indicating the decision to enter values for all the dependent anthropometric variables.

System Action: None

User Action: None.

CBM044I STANDARD ERROR MULTIPLICATION FACTOR RESET TO nnn.nn.

Issued By: CBMIND.

Reason: User has entered a new value for standard error of estimate.

System Action: Value changed internally.

User Action: None.

CBM045I USER CHOOSES TO INPUT 2 INDEPENDENT VARIABLES.

Issued By: CBMIND.

Reason: User has depressed PFK13, indicating the decision to enter values for two independent anthropometric variables.

System Action: None.

User Action: None.

CBM046A ANTHROPOMETRIC DIMENSION vblname REFERENCED BY LINK link name DOES NOT EXIST IN MEMBER membername.

Issued By: CBMIN1.
Reason: One of the vital anthropometric dimensions needed to generate the link length in question does not exist in the referenced survey member.
System Action: Program ends.
User Action: Print contents of referenced member from Anthropometric Data Base, using PRT function of CBMAM.

CBM047A ABNORMAL PROGRAM END.

Issued By: CBMIN1.
Reason: Key data vital to the construction of the man-model were not available.
System Action: Program ends.
User Action: Contact systems programmer.

CBM048I DATA WRITTEN FOR OFF-LINE PLOT NO. nn.

Issued By: CBMCP1.
Reason: Coordinate and index data for man-model and crew station configuration have been written onto disk file specified by FT11F001 DD card. nn is the plot number.
System Action: None.
User Action: None.

CBM049A I/O ERROR ON UNIT 11. OFF-LINE PLOT DATA nn NOT SAVED.

Issued By: CBMCP1.
Reason: Input-output error on file where coordinate data are written. Plot data for plot nn are not saved.
System Action: Return to calling program.
User Action: None.

CBM052I VISIBILITY PLOT GENERATED FOR visibility member.

Issued By: CBMVIS.
Reason: Successful completion of visibility plot.
System Action: None.
User Action: None.

CBM053A NUMBER OF COMBINATIONS OF INDEPENDENT VARIABLES SUPPLIED BY MEMBER survey name DOES NOT EQUAL THAT SUPPLIED BY MEMBER regression name.

Issued By: CBMIN1.
Reason: Values for number of independent combinations are different from number supplied by regression member.
System Action: Values supplied by regression member are used.
User Action: Contact systems programmer.

CBM054A NUMBER OF DEPENDENT VARIABLES SUPPLIED BY MEMBER survey name DOES NOT EQUAL THAT SUPPLIED BY MEMBER regression name.

Issued By:	CBMIN1.
Reason:	Values for number of dependent variables are different from number supplied.
System Action:	Values supplied by regression member are used.
User Action:	Contact systems programmer.

CBM055I UNIT 9 NOT A VISIBILITY DATA BASE.

Issued By:	CBMVIS.
Reason:	Identification record of Visibility Data Base is missing.
System Action:	Terminates Visibility Plot Function.
User Action:	Stop program if Visibility Plot is needed.

CBM056I TOO MANY VERTICES nn FOR BOUNDARY boundary name.

Issued By:	CBMVIS.
Reason:	The number of vertices on boundary exceeded 100.
System Action:	Unpredictable result on Visibility Plot.
User Action:	Limit number of vertices on any one boundary to 100.

CBM057I TO MANY POINTS nn FOR BOUNDARY boundary name.

Issued By:	CBMVIS.
Reason:	The number of points on any boundary exceeded 2500 (ie. the perimeter of the boundary exceeded 2500 inches).
System Action:	Unpredictable result on Visibility Plot.
User Action:	Limit the perimeter of the boundary to 2500 inches.

CBM058I END OF DATA ON UNIT 9.

Issued By:	CBMVIS.
Reason:	Insufficient data on Unit 9 to generate visibility plot.
System Action:	Return to calling program.
User Action:	Contact systems programmer.

SECTION 3

OFF-LINE PLOT PROGRAM (CBMOFF)

The CBMOFF is an off-line plot program which plots COMBIMAN data displayed on the IBM 2250 screen. When the user needs a plot which cannot be done On-Line,[1] the OFF-LINE PLOT COMBIMAN function (PFK7) is depressed to store the man-model and crew station data of the display currently on the CRT (see Paragraph 2.2.8). The user may store as many sets of these data as needed on data set unit 11 (see FT11F001 DD card on Figure 70). Program CBMOFF plots these data using Calcomp compatible software. The user specifies the data sets to be plotted, as well as plot size, color, and content.

The following information is intended as a programmer's guide to use the program CBMOFF.

3.1 AVAILABLE PROCESSING

The user specifies the contents and size of the plot as well as its color. This is done by providing the following two input cards along with the plot data file.

(1) the NAMELIST/CNTRL/, and

(2) a card with the plot numbers of those data sets not to be plotted.

The information supplied on these cards allows the user to vary plot size, plot color, and plot content as follows:

---

[1]At WPAFB AFAMRL we use a, 10" Model 5000 Gould electrostatic plotter for On-Line plots and a 3-color 30" Calcomp plotter with a resolution of 0.0002" for report quality output and quarter-scale Off-Line plots.

(1) The NAMELIST/CNTRL/'s variables and their default values:

FACTR - When specified, FACTR is the plot scale factor for that program run, otherwise, the scale factor specified for each plot during the COMBIMAN run when the data were generated (see Paragraph 2.2.8) is used.

LINKS, FLESH, and CRST - These three variables allow user to eliminate the link system, the enfleshment, and/or the crew station respectively from plots for that program run. Specifying LINKS, FLESH, and/or CRST equal to "1" deletes that element(s) from the plots. Using the default values

LINKS=0
FLESH=0, and
CRST=0

all elements on the CRT display are plotted.

(ICOLOR(I), I=1,4) - ICOLOR(I) determines the pen color for element "I" of the plot where,

I=1 is the plot banner,
I=2 is the link system,
I=3 is the enfleshment, and
I=4 is the crew station.

The default[2] values of the pen colors for plot banner, link system, enfleshment and crew station are:

ICOLOR(1)=1 for banner,
ICOLOR(2)=1 for link system,
ICOLOR(3)=2 for enfleshment, and
ICOLOR(4)=3 for crew station.

[2]When an off-line plot is made, the user specifies the color assignments.

The format of the Namelist CNTRL is as follows (see Figure 72):

column 1 - a blank
column 2 - a $[3]
column 3-7 - the word CNTRL
column 8 - a blank

After column 8 comes none, all, or any combination of the keyword control variables in the form FLESH=1, FACTR= .95, ICOLOR(2)=3, ..., the last one followed by a "$" indicating the end of the NAMELIST variable input.

(2) The second data card contains the plot numbers of the data to be skipped. The format for the data card is shown in Figure 73. The data card can contain up to twenty plot numbers, each right-justified integer in one of the 3-character fields in the first sixty columns of the card. These numbers can be in any order and do not need to fill consecutive fields. If the card is left blank, no plot will be skipped.

Figure 74 shows an Off-Line plot of the man-model with full skeletal link system and a crew station, as it appears on the CRT. The plot banner shown in Figure 75 indicates that the plot is a perspective plot with scale factor 0.85. The data card input for this plot is shown in Figure 76. Notice that all values except ICOLOR(3) and ICOLOR(4) remain at their default values in the NAMELIST/CNTRL/. This implies that the scale factor for the plot is the one specified during the COMBIMAN run when the plot data were generated. The link system, enfleshment, and crew station as displayed on the CRT are included in the plot. Since both ICOLOR(3) and ICOLOR(4) are

[3]The $ symbol is used while executing the program on a CDC computer: other computers may have different symbols for this purpose.

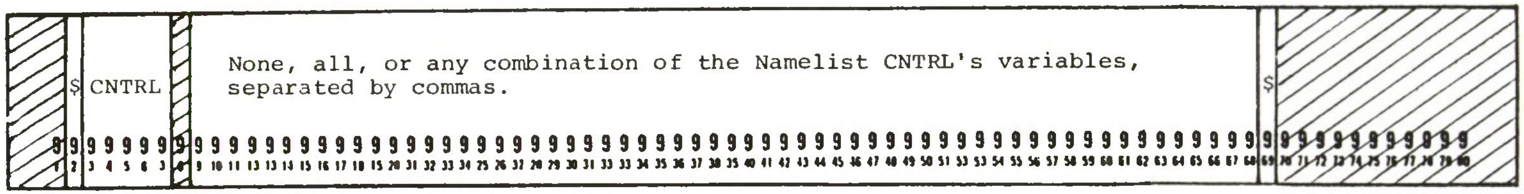


Figure 72. The Format of the Namelist CNTRL.

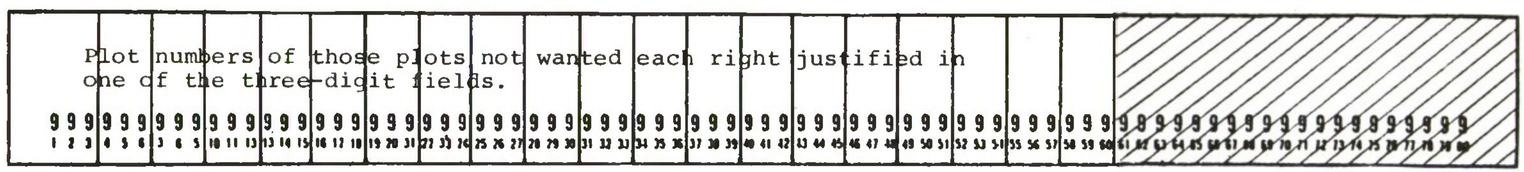


Figure 73. The Format of the Data Card for Unwanted Plots.

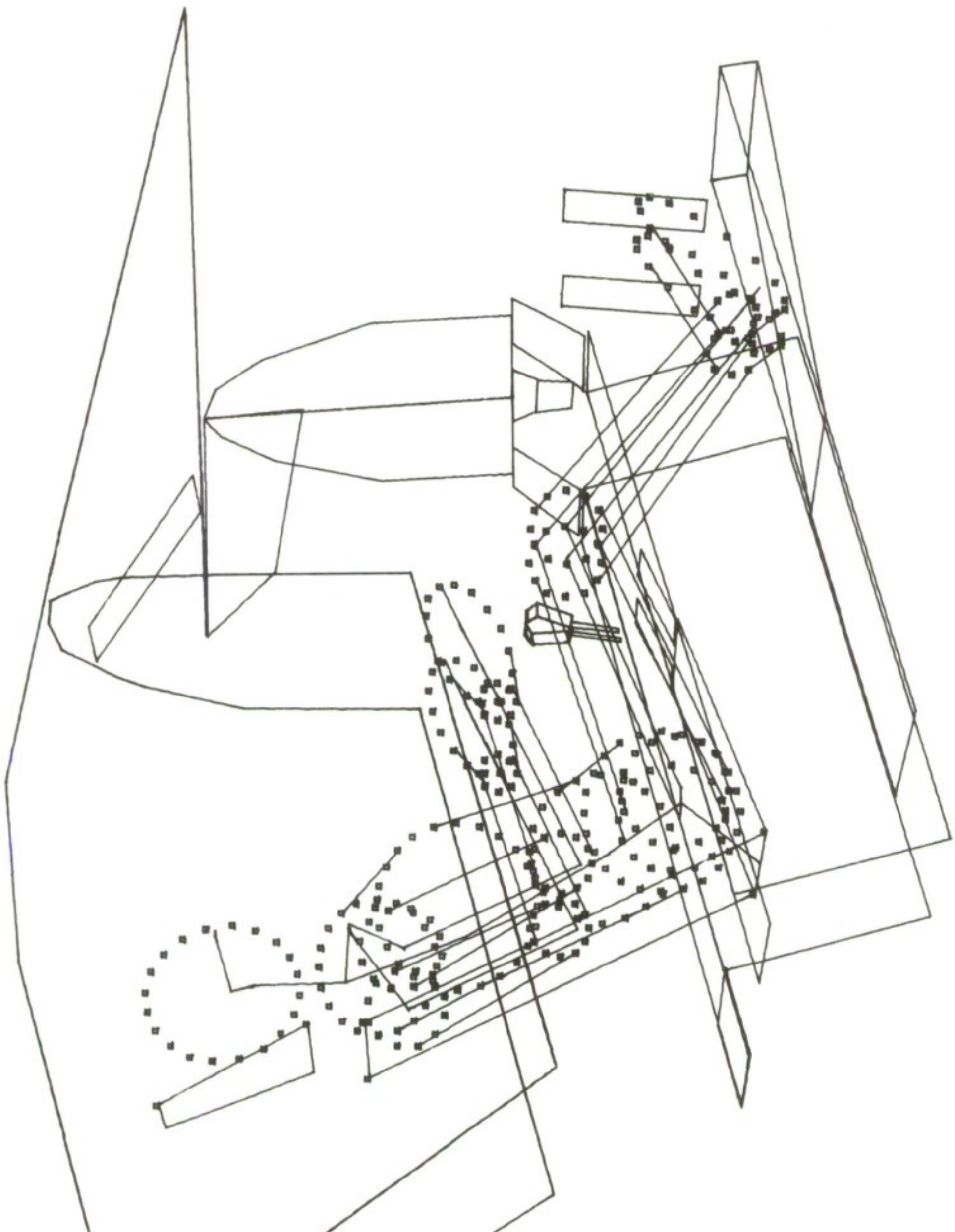


Figure 74. COMBIMAN OFF-LINE Plot.

REGRESS:R67 USAF
SURVEY:67 USAF
CRST:A7E-01
VIEW-PLANE:OFF AXIS
ROLL PITCH YAW
0.0 -15.0 15.0
PERSPECTIVE
SCALE=0.85
PLOT=2

Figure 75. Plot Banner for the Plot Shown in Figure 74.

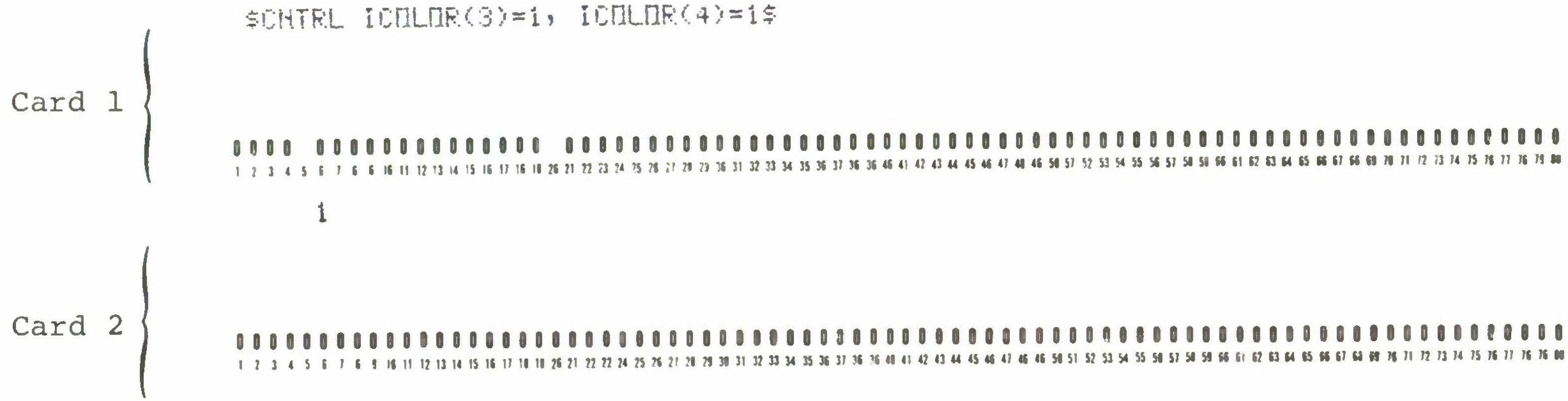


Figure 76. Card Input for Figure 74.

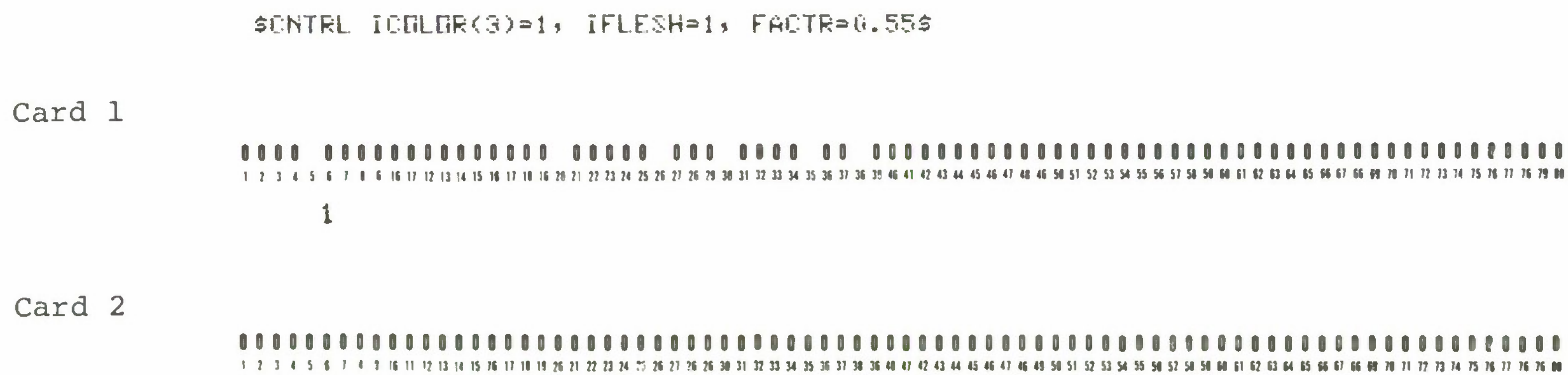


Figure 77. Card Input for Figure 78.

set equal to 1 in the input, all elements of the plot will be of the same color (in this case black). Also notice that the second input card contains a "1" in column six denoting that plot number 1 is to be skipped. The plot shown in Figure 74 is plot number "2" as indicated in Figure 75.

Figure 77 shows the input cards used to generate Figure 78 from the same plot data. FACTR=0.55 resets the plot scale factor to 0.55, FLESH=1 deletes all enfleshment from the man-model, and the color of all plot elements is again black.

3.2 PROGRAM MESSAGES-INFORMATION AND ERROR TYPE

The program CBMOFF prints both information and action related messages. The message format is as follows:

CBM2nni	message text

where:

CBM	identifies the message and indicates that the message originates from COMBIMAN system
2	identifies the message and indicates that the message originates from the program CBMOFF
nn	is the message number
i	indicates the action code (I=Informational, A=Action to be performed), and
message text	is the text of the message

CBM201I PLOT SET plotnumber WAS NOT PLOTTED -- BY REQUEST.

Reason:	User requested that plot plotnumber not be plotted.
System Action:	Plot plotnumber is not plotted.
User Action:	None.

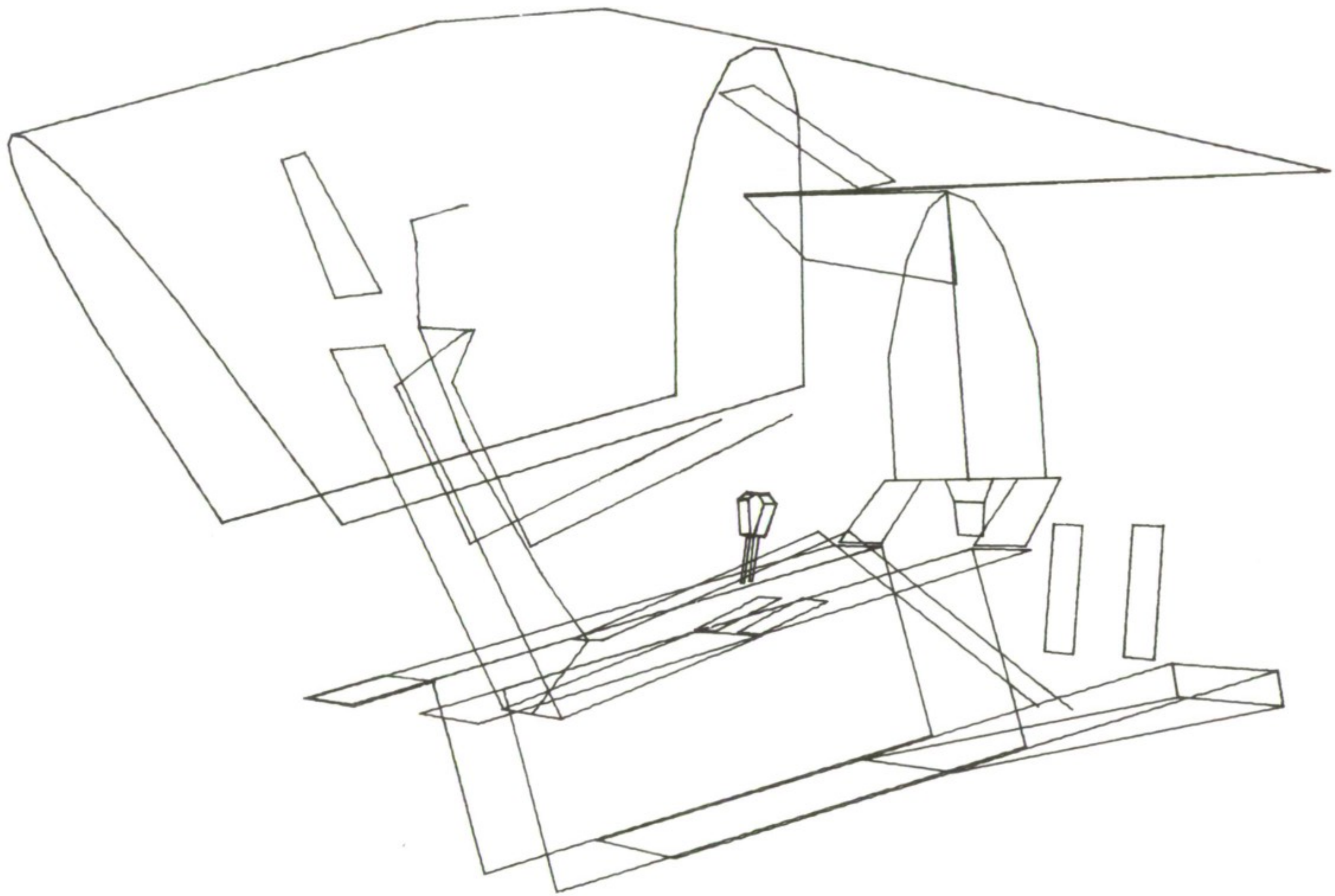


Figure 78. Altered COMBIMAN OFF-LINE Plot.

CBM202A INCORRECT AMOUNT OF DATA FOR PLOT plotnumber -- PROGRAM ENDING.

Reason:	There were too much or too little data on file for plot plotnumber.
System Action:	No plotting occurs, and program ends.
User Action:	Recreate plot file.

CBM203I SCALE FACTOR CHANGED FROM factor1 TO factor2.

Reason:	User input a value for FACTR (factor2) in the namelist CNTRL.
System Action:	factor2 is used to scale the plot.
User Action:	None.

SECTION 4
COMBIMAN ANTHROPOMETRIC DATA BASE MAINTENANCE PROGRAM (CBMAM)

In order to generate an accurate and sophisticated man-model like the one in COMBIMAN, the user is often requested to supply a lot of anthropometric data. To simplify this task, a Data Base is constructed to store key data items. This Data Base resides on a direct-access disk, and contains anthropometric survey and regression data which are relevant to generate the man-model.

The information on the Data Base is organized into groups of related records called members. Members may be either regression data, or anthropometric survey data. Data for survey members are generally subsets of existing anthropometric surveys in the AFAMRL Anthropometric Data Bank. In order to add a new anthropometric survey to the Data Base, the key information needed includes the mean and standard deviation for each anthropometric variable and a set of correlation coefficients for all the relevant variables of the survey.

4.1 AVAILABLE PROCESSING

The program CBMAM (COMBIMAN Anthropometric Data Base Maintenance Program) allows the user to create and maintain the Anthropometric Data Base. The user supplies the input data on 80 character computer cards or in card image format on magnetic tape. The program CBMAM reads and processes the data in accordance with the selection of control commands by the user. These commands allow the user to add members to the Data Base, to delete members from the Data Base, to print or punch existing members, to list the directory of the Data Base, or to compress the data on the file to combine unused space. The data flow of the program is shown in Figure 79.

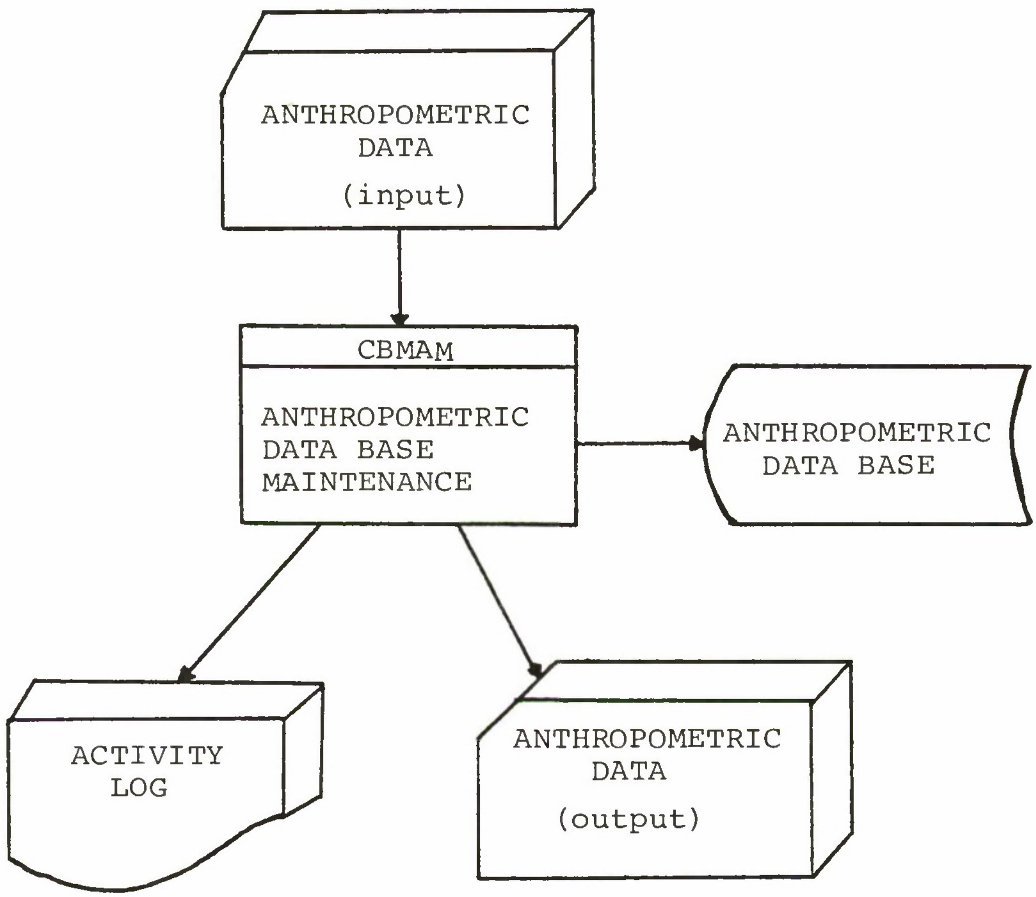


Figure 79. Data Flow for Program CBMAM.

The Anthropometric Data Base is made up of two types of related data. One type consists of regression data which is used by the interactive graphics program CBM05 to compute the anthropometric surface dimensions needed to generate the link system of the man-model. The second type consists of survey data which define the means, standard deviations, and percentiles for each variable for a particular survey. Each group of data, whether dealing with regression or survey information, is called an anthropometric member, and is referenced by its member name and type classification.

4.2 RESTRICTIONS AND LIMITATIONS

The Anthropometric Data Base may contain up to a maximum of 20 members consisting of regression and survey types. The number of records for each member need not be the same and the sum of the record counts for all the members cannot exceed 1979. Information on the number of members on the Data Base and their sizes is obtained by using the "+PRT" control command as explained in detail in Paragraph 4.3.2.9

Additional limitations on the number of variables and related data are explained in Paragraph 4.3.2. Members to be added should have unique membernames. If the new member name matches with any name in the directory, the member will not be added.

4.3 HOW TO USE PROGRAM CBMAM

The surveys used in COMBIMAN are subsets of 1967 Survey of the USAF Flying Personnel (Churchill, et al, 1976), the 1970 Survey of the U.S. Army Aviators (Churchill, et al, 1971), the 1968 Air Force Women, and the 1964 U.S. Navy Flyers. As new surveys become available, or subsets of existing surveys in the

AFAMRL Data Bank become needed, the program CBMAM is used to add these new members. In most cases, each new survey type member has a corresponding regression type member which contains multiple and single regression equation coefficients to predict additional anthropometric variables from those specified by the user. In a few cases, one regression type member may be referenced by several survey type members. These are special cases and this practice should not be used regularly without first consulting with personnel in the Workload and Ergonomics Branch of the Air Force Aerospace Medical Research Lab, Wright-Patterson Air Force Base, Ohio to verify the statistical accuracy of the regression data of the anthropometric survey in question.

All examples illustrating the use of CBMAM will be based on the 1967 USAF Flying Personnel survey and its regression member R67 USAF.

4.3.1 Input Data Specification

The nucleus of the anthropometric variables considered for input as part of any anthropometric survey member is the 12 variables required to generate the 35 internal link lengths of the man-model skeletal system. The names of these variables and their abbreviated 16 character names, where applicable, are listed in Table 5. Very few COMBIMAN users will have specific values to input for each of the 12 variables. In order to accommodate this, we have selected additional anthropometric variables which are found to be good predictors of either body segment mass or body segment length, and have moderately high correlations with the 12 required variables. The variables chosen to predict mass and length related variables for the 1967 Survey are shown in the appropriate columns of Table 6. The variables in Table 6 which are both predictors and required dependent dimensions are marked with an asterisk.

TABLE 5

LIST OF DEPENDENT VARIABLES NEEDED TO GENERATE COMBIMAN LINK SYSTEM

	Name	16 Character Abbreviation (If Applicable)
1.	Weight	
2.	Sitting Height	
3.	Acromion Height, Sitting	(ACROMION HGT/SIT)
4.	Knee Height, Sitting	(KNEE HGT/SITTING)
5.	Buttock-Knee Length	(BUTTOCK-KNE LGTH)
6.	Shoulder-Elbow Length	(SHOULDR-ELB LGTH)
7.	Biacromial Breadth	(BIACROMIAL BRDTH)
8.	Hip Breadth	
9.	Chest Depth	
10.	Foot Length	
11.	Hand Length	
12.	Elbow-Wrist Length	(ELBOW-WRIST LGTH)

TABLE 6

LIST OF DEPENDENT VARIABLE PREDICTORS

Mass Related	Length Related
1. *Weight	1. *Sitting Height
2. Bideltoid Breadth	2. Eye Height, Sitting
3. Hip Breadth, Sitting	3. *Knee Height, Sitting
4. *Chest Depth	4. *Buttock-Knee Length
	5. Elbow-Grip Length
	6. Thumb-Tip Reach

*Predictors and required dependent variables.

To generate the man-model the user may also select one mass related and one length related variables from Table 6 and supply their values. The values for all the 12 variables in Table 5 are computed using the regression equations from the Anthropometric Data Base.

In order to create an anthropometric survey member, first a set of variables based on availability and necessity has to be established. Once the complete set of variables is established, the means, standard deviations, percentiles, and correlation coefficients for each variable of the particular survey may be obtained from the AFAMRL Anthropometric Data Bank. The set of variables used for the 1967 Survey is shown in Table 7. A sample data obtained for Weight are shown in Figure 80.

The coefficients used in the regression equations are based on means, standard deviations and correlation coefficient for each variable, and on the equations which were developed in WADD-TR-60-31, pages 69-70 (Zeigen, et al, 1960). Tables 8 and 9 show the elements of the correlation coefficient matrices used in calculating the regression coefficients. The means, standard deviations, and correlation coefficients for 1967 USAF survey are available in AMRL-TR-77-2 (Churchill, et al, 1978).

The total number of multiple regression equations (NR) needed for a particular survey is calculated using the following equation:

$$NR = (NM \times NL) \times ND \qquad (1)$$

where NM is the number of variables related to body segment mass, NL is the number of variables related to body segment length, and ND is the number of dependent variables. For 1967 Survey, each of the 24 combinations of mass-length-related

TABLE 7

LIST OF ANTHROPOMETRIC DIMENSIONS
AVAILABLE IN THE ANTHROPOMETRIC DATA BASE

1. Weight
2. Sitting Height
3. Eye Height, Sitting
4. Acromion Height, Sitting
5. Knee Height, Sitting
6. Buttock-Knee Length
7. Shoulder-Elbow Length
8. Elbow-Grip Length
9. Thumb-Tip Reach
10. Biacromial Breadth
11. Bideltoid Breadth
12. Hip Breadth
13. Hip Breadth, Sitting
14. Chest Depth
15. Foot Length
16. Hand Length
17. Elbow-Wrist Length

VARIABLE NAME: WEIGHT

MEAN: 173.60 LBS

STANDARD DEVIATION: 21.44 LBS

PERCENTILE DATA:

Percentile	1	2	3	5	10	15	20	25	30
Weight	127.58	132.63	135.82	140.15	146.89	151.53	155.27	158.56	161.56
Percentile	35	40	45	50	55	60	65	70	75
Weight	164.37	167.08	169.74	172.42	175.13	177.92	180.84	183.97	187.41
Percentile	80	85	90	95	97	98	99		
Weight	191.32	195.91	201.83	210.76	216.62	220.94	227.73		

Figure 80. Sample Data Obtained from Summary Statistics of the Air Force Rated Officers. (Churchill et al, 1976)

TABLE 8

MATRIX OF CORRELATION COEFFICIENTS BETWEEN
MASS AND LENGTH RELATED VARIABLES (CHURCHILL, ET AL, 1976)

	Sitting Height	Eye Hgt. Sitting	Knee Hgt. Sitting	Butt-Knee Length	Elbow-Grip Length	Thumb-Tip Reach
Weight	.4568	.4119	.5386	.4544	.4085	.4138
Bideltoid Brdth.	.2782	.2598	.3398	.4379	.2514	.2784
Hip Brdth., Sitting	.3755	.3457	.4283	.5502	.3432	.3270
Chest Depth	.3333	.3078	.4084	.5479	.2882	.2965

TABLE 9

DEPENDENT AND INDEPENDENT VARIABLES (CHURCHILL, ET AL, 1976)

DEPENDENT VARIABLES	INDEPENDENT VARIABLES									
	Weight	Sitting Height	Eye Height (S)	Knee Height (S)	Buttock-Knee Length	Forearm-Grip Length	Thumb-Tip Reach	Bideltoid Breadth	Hip Breadth (S)	Chest Depth
Weight	1.00	.4576	.4130	.5390	.6361	.4080	.4143	.7966	.8549	.7594
Sitting Height	.4568	1.00	.9302	.5148	.3917	.4613	.4138	.2782	.3333	.1299
Acromion Height (S)	.4862	.8126	.7780	.4452	.3382	.3823	.3482	.2676	.3916	.2008
Knee Height (S)	.5386	.5148	.4876	1.00	.7851	.7817	.7002	.3398	.4084	.2853
Buttock-Knee Length	.6363	.3917	.3897	.7851	1.00	.6238	.6041	.4379	.5479	.4168
Shoulder-Elbow Length	.3995	.4573	.4584	.7500	.6967	.6743	.6752	.2515	.2997	.2092
Biacromial Breadth	.4516	.3491	.2964	.3745	.2954	.3481	.3235	.6571	.3202	.2681
Hip Breadth	.8094	.3755	.3457	.4283	.5502	.3432	.3270	.6225	.9031	.5803
Chest Depth	.7593	.1299	.1065	.2853	.4168	.2034	.2523	.6240	.6318	1.00
Foot Length	.4711	.4786	.4497	.6919	.5957	.6517	.5545	.3067	.3498	.2445
Hand Length	.3889	.4506	.4155	.6539	.5432	.7070	.5757	.2553	.2578	.2005
Elbow-Wrist Length	.4136	.4340	.3699	.7826	.6260	.8994	.6865	.2619	.2993	.2122

dimensions has its own set of 12 multiple regression equations to compute the surface dimensions required to generate the man-model. In addition to the multiple regression coefficients, simple regression coefficients and associated standard error of estimates are available for each of the 24 combinations. Note that the standard units of measurement for all variables used in COMBIMAN are pounds and inches, but there are provisions to change these into metric units.

4.3.2 Processing Specification

The Anthropometric Data Base Maintenance program, CBMAM, allows the user to create and maintain the Anthropometric Data Base. The Data Base contains regression data which are used by the interactive graphics program CBM05 to predict anthropometric surface dimensions needed to generate the link system of the man-model. It also contains survey data which define the means, standard deviations, and percentiles for every defined variable for a particular anthropometric survey. Each group of data, whether dealing with regression or survey information, is called an anthropometric member, and is referenced by its member name and type classification.

The program CBMAM allows the user to maintain the Data Base by adding, deleting, listing, etc., the member types through input control cards as shown in Figure 81.

These control cards may be placed in any order in the input stream of the program, with one exception. If the Data Base is initialized for the first time, the +INT control card must be the first data card. In the following paragraphs, the control cards format of the function is listed first. This is followed by the text which explains each keyword. Additional data formats, if any, are then described for each function.

A1	A4		A8	I4	I4	I4	I4	I4	A8		
+	opr		member name	type	nvbl	ncmb	ndep	npct	regr name		Optional Sequence Number
1	2 3 4	5	6 7 8 9 10 11 12 13	14 15 16 17	18 19 20 21	22 23 24 25	26 27 28 29	30 31 32 33	34 35 36 37 38 39 40 41	42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72	73 74 75 76 77 78 79 80

Figure 81. Program CBMAM Control Card Format.

4.3.2.1 ADD ANTHROPOMETRIC MEMBER Function

+ADD membername type nvbl ncmb ndep regrname (followed by member definition)

The ADD ANTHROPOMETRIC MEMBER function, as defined by the +ADD control card and the member definition cards which follow, adds to the Anthropometric Data Base specified data under the name membername. The membername is an alphanumeric character string, whose length is limited to 16 characters. The type field distinguishes between the two types of members. A type value of "0" indicates that the member contains regression information, while a type value of "1" indicates that the member contains survey dimension data. The type value, as well as all other integer values supplied on the control card, must be right-justified within its field. The nvbl field defines the total number of variables described in member membername. The maximum number is 45. The ncmb field indicates the maximum number of combinations of independent mass and length variables. The maximum number is 50. The number of anthropometric variables needed to determine the internal link lengths is supplied in field ndep. The maximum number is 30. Fields, npct and regrname are used only when the type field value is 1. Npct contains the number of percentile values which will be supplied for every one of the nvbl variables. The maximum value for npct is 30. The regrname field refers to the type 0 membername which contains the appropriate regression information.

4.3.2.2 TYPE 0 MEMBERS

An example of an +ADD control card for a type 0 member in the 1967 Survey is outlined in Figure 82. The name of the survey member is R67 USAF, and it contains a total of 17 variables, with 24 combinations of independent variables, and 121 combinations of dependent variables. An example of a

```
+ADD R67 USAF     0  17   24   12
  1 WEIGHT           LB    1          1
  2 SITTING HEIGHT   IN          1    1
  3 EYE HGT/SITTING  IN          1
  4 ACROMION HGT/SIT IN               1
  5 KNEE HGT/SITTING IN          1    1
  6 BUTTOCK-KNE LGTH IN          1    1
  7 SHOULDR-ELB LGTH IN               1
  8 ELBOW-GRIP LGTH  IN          1
  9 THUMB-TIP REACH  IN          1
 10 BIACROMIAL BRDTH IN               1
```

Ref. Fig. 81

Ref. Fig. 84

Figure 82. Example of +ADD Control Card for Type 0 Member.

```
+ADD 67 USAF      1  17   24   12   25   R67 USAF
 1 2 3 510152025303540455055606570758085909597989 9-
 1 WEIGHT             LB 173.60686 21.434704127581326313582140151468915153
1552715856161561643716708169741724217513177921808418397187411913219591
2018321076216622209422773
 2 SITTING HEIGHT   IN 36.685932 1.2501624 3394 3424 3444 3470 3511 3539
 3562 3582 3600 3617 3633 3649 3665 3681 3698 3715 3733 3753 3775 3801
 3833 3880 3910 3931 3962
 3 EYE HGT/SITTING  IN 31.869176 1.1871142 2917 2950 2971 2998 3038 3065
 3087 3106 3123 3138 3153 3168 3183 3198 3213 3229 3246 3265 3286 3311
 3343 3390 3421 3443 3478
 4 ACROMION HGT/SIT IN 24.03821  1.123410  2142 2177 2197 2224 2263 2289
 2310 2327 2343 2358 2373 2387 2401 2415 2430 2445 2461 2479 2499 2522
 2551 2594 2620 2639 2666
```

Ref. Fig. 81

Ref. Fig. 88

Ref. Fig. 89

Figure 83. Example of +ADD Control Card for Type 1 Member.

+ADD control card for a _type_ 1 member is outlined in Figure 83. The number of percentiles for each variable of survey member 67 USAF is 25, and the referenced regression type member is R67 USAF. Note that the values for _nvbl_, _ncmb_, and _ndep_ are identical to the _type_ 0 member R67 USAF, shown in Figure 82.

Figures 84, 85, and 86 shows the record formats used for type 0 members in the data base. The data provided in the format shown in Figure 84 define anthropometric variables used in the regression member. Columns 1-2 contain a sequence number for the variable, right-justified in the field. Columns 4-19 contain the 16-character name of the anthropometric variable. Columns 21-22 contain a two-character abbreviation for the default unit of measurement of the variable. Approved abbreviations are IN, CM, MM, LB, and KG for inches, centimeters, millimeters, pounds, and kilograms, respectively. A "1" punched in column 26, 30, or 34, indicates a mass related independent variable, a length related independent variable, or a dependent variable necessary to generate the link lengths respectively. A variable can either be independent or dependent, as in the case of sitting height, but it cannot pertain to both mass and length. If all three fields are blank, the data card is flagged to indicate an error. As each variable definition card is read in, the program checks the use of the variable and records its status.

The first outlined area of Figure 87 is an example of a Variable Definition Card. A "1" is punched in columns 30 and 34 to indicate that the Sitting Height is both an independent variable related to body segment length and a dependent variable.

Two types of record formats are used for combinations of mass and length related independent variables as shown in Figures 85 and 86. In Figure 85, the variable

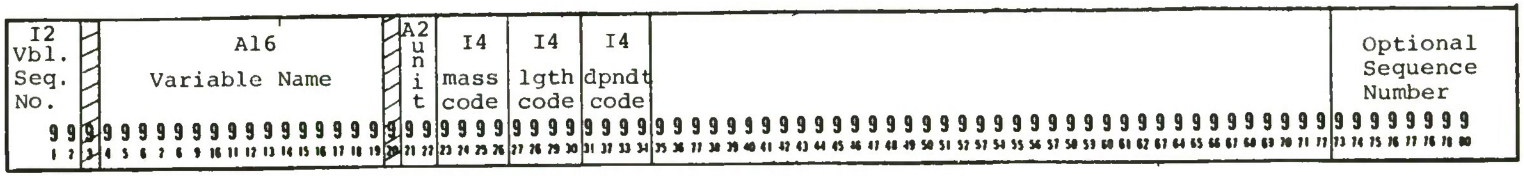


Figure 84. Program CBMAM Regression Member Variable Definition Card.

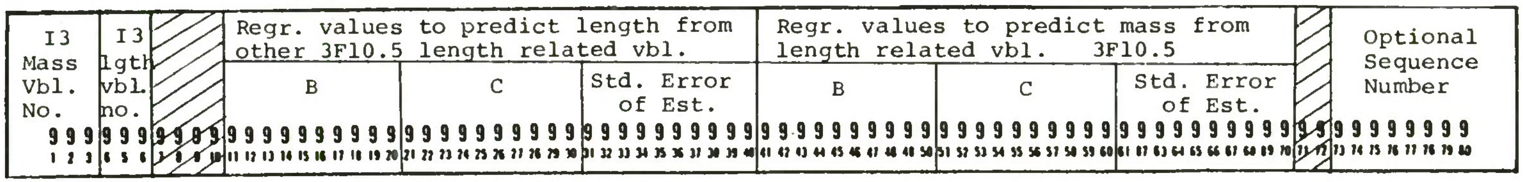


Figure 85. Program CBMAM Regression Member Simple Regression Coefficient Definition Card.

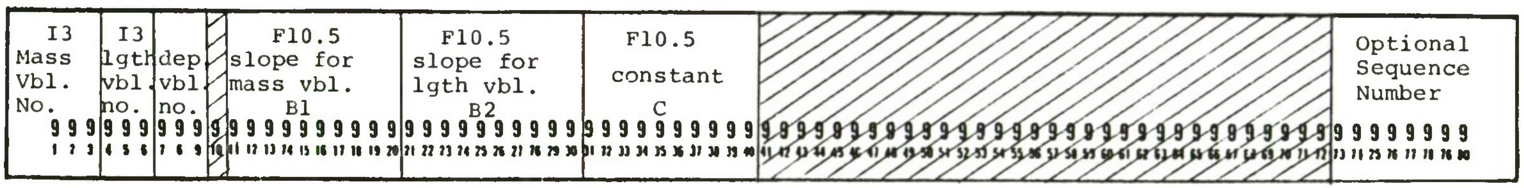


Figure 86. Program CBMAM Regression Member Multiple Regression Coefficient Definition Card.

```
+ADD R67 USAF    0  17  24  12
 1 WEIGHT             LB   1       1
 2 SITTING HEIGHT     IN       1   1                                    (1)
 3 EYE HGT/SITTING    IN       1
 4 ACROMION HGT/SIT   IN           1
 5 KNEE HGT/SITTING   IN       1   1
 6 BUTTOCK-KNE LGTH   IN       1   1
 7 SHOULDER-ELB LGTH  IN           1
 8 ELBOW-GRIP LGTH    IN       1
 9 THUMB-TIP REACH    IN       1
10 BIACROMIAL BRDTH   IN           1
11 BIDELTOID BRDTH    IN   1
12 HIP BREADTH        IN           1
13 HIP BREADTH/SITT   IN   1
14 CHEST DEPTH        IN   1       1
15 FOOT LENGTH        IN           1
16 HAND LENGTH        IN           1
17 ELBOW-WRIST LGTH   IN           1
  1  2       0.02669  32.05275    1.11161   7.84538-114.20831  19.05910  (2)
  1  2  1  1.0        0.0          0.0
  1  2  2  0.0        1.0000000    0.0
  1  2  4             .731        -2.779522
  1  2  5             .404         7.133844                              (3)
  1  2  6             .333        11.566906
  1  2  7             .247         5.090541
  1  2 10  0.0131732 0.1105000     9.69417
  1  2 12  0.0279173 0.0043000     8.87957                               (4)
  1  2 14  0.0313031-0.1665000    10.32958
  1  2 15  0.0069724 0.1248000     4.85468
  1  2 16             .117         3.232277
  1  2 17             .193         4.728337
  1  3       0.02287  27.89858    1.08116   7.45657 -64.02781  19.52158
  1  3  1  1.0        0.0          0.0
  1  3  2             0.979        5.484241
  1  3  4             0.737        0.55118
```

Figure 87. Example of Regression, or Type 0 Member.

numbers, punched in columns 1-3 and 4-6 are obtained from columns 1-2 of the variable definition cards as shown in Figure 84. Columns 11-40 contain simple regression information necessary to predict the length related variable from the mass related variables. This information includes the slope and constant in the regression formula:

$$Y = bX + c \qquad (2)$$

where:

b is the slope and
c is the intercept.

It also contains the standard error of estimate associated with the equation. Columns 41-70 contain similar data to predict mass from the length variable.

The regression data used in the following examples are unpublished data provided by the USAF. These data contain the slope, intercept, and standard error in metric units. The coefficients are multiplied by appropriate factors to convert them to the English units specified on the Variable Definition Card. The regression equation to predict sitting height in inches from weight in pounds is:

$$\underset{\text{(Variable \#2)}}{\text{Estimated Sitting Height}} = 0.02669 \times \underset{\text{(Variable \#1)}}{\text{Actual Weight}} + 32.05275 \qquad (1)$$

The standard error is 1.11161.

The equation to predict weight in pounds from sitting height in inches is:

Estimated Weight = 7.84538 x Actual Sitting Height - 114.20831 (2)

The standard error is 19.05910.

In Figure 87 (2), the "1" in column 3 identifies Weight as the mass related variable, and the "2" in column 6 identifies Sitting Height as the length related variable. The regression coefficients for equations (1) and (2) are punched in the remainder of the card.

The second record format is shown in Figure 86 and contains the multiple regression information necessary to predict each dependent variable from the particular combination of mass and length related variables. Columns 1-3 contain the independent mass variable number; columns 4-6 the independent length variable number; and columns 7-9 the dependent variable number. Each integer value must be right-justified. Columns 11-20 contain the slope associated with the mass variable value (b_1); columns 21-30 the slope for the length variable value (b_2); and columns 31-40 the constant of the equation (c). The equation to predict the value y of a dependent variable is of the form:

$$Y = b_1X_1 + b_2X_2 + c \qquad (3)$$

where:

X_1 is the value of mass related variable and
X_2 is the value of length related variable.

The data for this card are derived from the correlation matrices shown in Tables 8 and 9, and from the equations in Zeigen, et al, (1960). Since it is undesirable to have the length related variables to depend on the value chosen for the mass related variable, the multiple regression equations are replaced by single regression equations. As an example, the multiple regression equation to predict Knee Height/Sitting from Weight and Sitting Height is replaced by a single regression equation as follows:

Knee Height/Sitting = 0.0 x Weight (Variable #1)
+ 0.404000 x Sitting Height (Variable #2)
+ 7.133844

The third outlined area of Figure 87 shows the data for this example. A "1" in column 3 identifies Weight as the mass variable; a "2" in column 6 identifies Sitting Height as the length variable; and a "5" in column 9 identifies Knee Height/Sitting as the dependent variable. The regression coefficients are punched in the remainder of the card.

The multiple regression equations are retained for predicting the mass-related variables. As an example, the multiple regression equation to predict Hip Breadth from Weight and Sitting Height is as follows:

Hip Breadth = 0.0279173 x Weight (Variable #1)
+ 0.0043000 x Sitting Height (Variable #2)
+8.87957

The fourth outlined area of Figure 87 shows the data for this example. A "1" in column 3 identifies Weight as the mass variable; a "2" in column 6 identifies Sitting Height as the length variable; and a "12" in columns 8 and 9 identifies Hip Breadth as the dependent variable. The regression coefficients are punched in the remainder of the card.

If the number of multiple regression coefficient definition data cards is not equal to (ncmb x ndep) the member is not added to the Anthropometric Data Base.

4.3.2.3 TYPE 1 MEMBERS

For type 1 members on the Data Base, the record formats are shown in Figures 88 and 89. The input data in the format shown in Figure 88 define the percentile names for which values are supplied in succeeding cards. Figure 90 shows the percentile names for the 1967 USAF Survey. The 25 percentile values available for this survey include the 1st, 2nd, 3rd, 5th, and are punched in two-digit integer fields, right-justified within the area. The number of percentiles supplied must be equal to the value in the _npct_ field of the +ADD (type 1) control card, otherwise an error message is printed and the member is not added. Note that the maximum number of percentiles allowed is 30.

Figure 89 shows the format used in assigning dimensional values to the variables. The variable number in integer format is in columns 1-2 while columns 4-19 contain the 16-character variable name. Columns 21-22 contain the two character abbreviation for the default unit of measurement. At present the default or standard unit for weight is pounds, and the standard unit for all other measurements is inches. For each variable number, the variable name and unit of measurement must correspond with the same fields in the reference type 0 or regression member. Columns 23-32 contain the overall mean for the named variable expressed in the default unit of measurement. Columns 33-42 contain the standard deviation. Columns 43-72 of this data card and columns 1-70 of additional cards necessary to input data contain the values for each of the percentiles named. If the number of percentile values does not correspond to the value of _npct_, an error

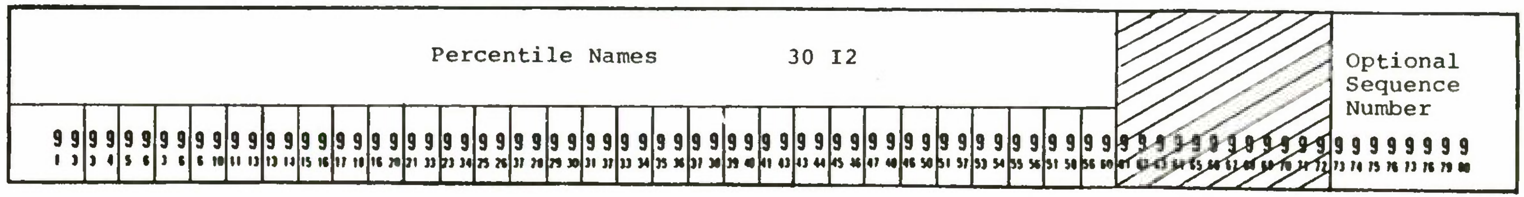


Figure 88. Program CBMAM Survey Member Percentile Definition Card.

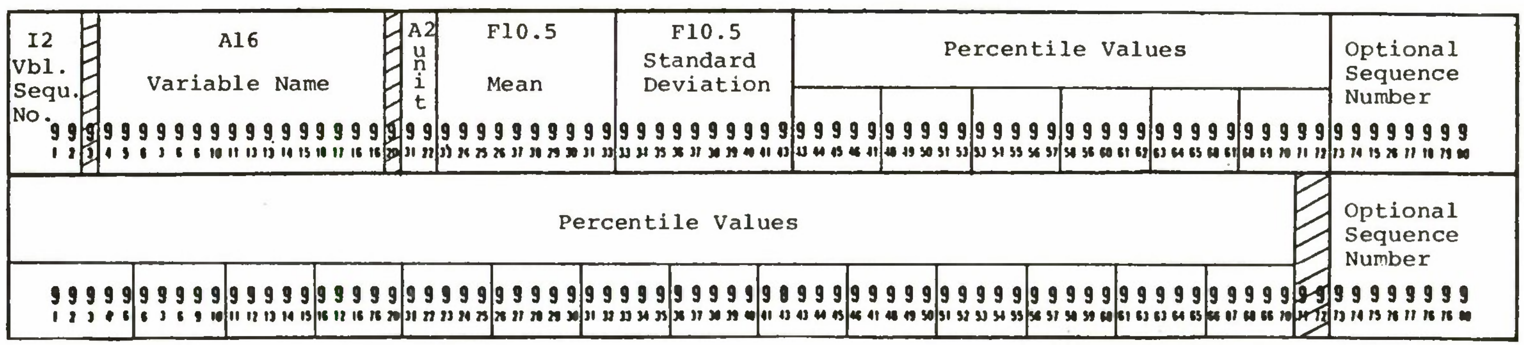


Figure 89. Program CBMAM Survey Member Dimension Definition Cards.

```
+ADD 67 USAF     1  17  24  12  25  R67 USAF
 1 2 3 51015202530354045505560657075808590959799
 1 WEIGHT            LB 173.60686 21.43470412758132631358214015146891515 3
15527158561615816437167081697417242175131779216084183971874119132195 91
2018321075216622209422773
 2 SITTING HEIGHT   IN 36.685332 1.2501624 3394 3424 3444 3470 3511 3539
 3562 3582 3600 3617 3633 3649 3665 3681 3698 3715 3733 3755 3775 3801
 3833 3880 3910 3931 3962
 3 EYE HGT/SITTING  IN 31.869176 1.1871142 2917 2950 2971 2998 3038 3065
 3087 3106 3123 3138 3153 3168 3183 3198 3213 3229 3246 3265 3285 3311
 3343 3390 3421 3443 3478
 4 ACROMION HGT/SIT IN 24.03821  1.123410  2142 2177 2197 2224 2263 2289
 2310 2327 2343 2358 2373 2387 2401 2415 2430 2445 2461 2479 2499 2522
 2551 2594 2620 2639 2666
 5 KNEE HGT/SITTING IN 21.95673   .98041   1973 1998 2015 2037 2071 2095
 2113 2129 2143 2157 2169 2182 2194 2206 2219 2231 2245 2260 2277 2296
 2322 2360 2386 2405 2436
 6 BUTTOCK-KNE LGTH IN 23.78431  1.06204   2138 2165 2183 2207 2244 2269
 2289 2306 2322 2336 2350 2363 2376 2389 2402 2416 2431 2447 2465 2486
 2514 2557 2587 2610 2648
 7 SHOULDR-ELB LGTH IN 14.15382   .674011  1265 1281 1291 1306 1329 1345
```

Ref. Fig. 81

Ref. Fig. 80

Ref. Fig. 89

Figure 90 . Example of Survey, or Type 1, Member.

condition occurs and the member is not added to the Data Base. The period in the fields in Figures 88 and 89 indicates the standard or default location of the decimal point in real number format.

The dimension data needed in this card are also obtained from the Summary Statistics of the 1967 Survey (Churchill et al, 1976). A sample set of the data for Weight is shown in Figure 80. The mean value of Weight, 173.60686 lbs, the standard deviation, 21.434704, and the weights associated with the first six percentiles, namely the 1st, 2nd, 3rd, 5th, 10th, and 15th are punched on the third card shown in Figure 90. The weight values for the percentiles ranging from 20th to 85th, and from 90th to 99th, are punched in the last card. It is essential that users enter a type 0 member into the Data Base prior to adding the associated type 1 member, since the type 1 member references the type 0 member.

4.3.2.4 CHECK ANTHROPOMETRIC MEMBER Function

+CHK membername type nvbl ncmb, ndep npct regr name

The CHECK ANTHROPOMETRIC MEMBER function operates the same way the ADD ANTHROPOMETRIC MEMBER function. However, the member is not added but the data are checked for errors.

4.3.2.5 DELETE ANTHROPOMETRIC MEMBER Function

+DEL membername type

The DELETE ANTHROPOMETRIC MEMBER function removes the specified member from the Data Base, but does not make the space occupied by the member available for reuse. The +CMP function must be used to accomplish this.

4.3.2.6 COMPRESS ANTHROPOMETRIC DATA BASE Function

+CMP

The COMPRESS ANTHROPOMETRIC DATA BASE function makes space available for storing anthropometric data by compressing used space together and maximizing the amount of continuous unused space on the Data Base. The intermediate blocks of unused space are created by the DELETE ANTHROPOMETRIC MEMBER function. The greater the activity of the Anthropometric Data Base (ie., +ADD's and +DEL's), the more often it becomes necessary to use this +CMP function. If the message "CBM310A INSUFFICIENT SPACE REMAINING TO ADD MEMBER membername" appears while adding a member, it becomes necessary to use the +CMP function. If the +ADD function gives the CBM310A message immediately following the +CMP function, the Data Base is full and no new members can be added until an existing member is deleted from the Data Base.

4.3.2.7 DUMP ANTHROPOMETRIC MEMBER Function

+DMP membername type
+DMP

The DUMP ANTHROPOMETRIC MEMBER function prints the contents of the anthropometric member membername of specified type, or prints the complete Anthropometric Data Base if no member name is given on the control card. This function is used primarily by system programmers to check the contents of the file.

4.3.2.8 END PROGRAM Function

+END

The END PROGRAM function control card terminates execution of the program CBMAM and returns control to the operating system.

4.3.2.9 INITIALIZE ANTHROPOMETRIC DATA BASE Function

+INT

The INITIALIZE ANTHROPOMETRIC DATA BASE function initializes an Anthropometric Data Base or resets an existing Anthropometric Data Base to its original unused state. All members residing on the Data Base before invoking this function are purged and the entire space is made available for new members. However, the primary purpose of this function is to establish an Anthropometric Data Base.

4.3.2.10 PUNCH ANTHROPOMETRIC MEMBER Function

+PCH membername type

The PUNCH ANTHROPOMETRIC MEMBER function punches a copy of the specified member in the same format as the ADD ANTHROPOMETRIC MEMBER function input data for the specified type onto computer cards. If the user specifies a member name that does not exist on the directory, all the member names on the Data Base directory are printed out. This function does not add or remove any member from the Data Base.

4.3.2.11 PRINT ANTHROPOMETRIC MEMBER Function

+PRT membername type
+PRT

The PRINT ANTHROPOMETRIC MEMBER function prints the contents of the specified member, membername, of type, type, in a format similar to that used in the ADD ANTHROPOMETRIC MEMBER function. If no name is specified, or if a name that is not in the Data Base directory is specified, names of all members in the Data Base directory, the number of records for each member, their types, and any additional data supplied on the +ADD control card when the members were added to the Data Base are printed.

4.3.3 Submitting a Processing Request

The set of JCL used at HESS facility to run the program CBMAM is shown in Figure 91. Use of the //FT02F001 DD card as shown in Figure 91 assumes that the space for the Data Base has already been allocated and catalogued. If for some reason this condition is not met, the //FT02F001 DD card in Figure 91 should be replaced by the card sequence (3 cards) shown in Figure 92. The job is run with this replacement series once to allocate space for the data set (file) on disk, and to catalogue the file. Thereafter the simplified //FT02F001 DD card shown in Figure 91 is used to maintain the Data Base.

If the file has just been created, or if the user wants to reinitialize the file, the +INT control function is used before any other control function.

The last control card read into the program should be the +END control card.

4.3.4 Output Data Interpretation

The program CBMAM generates output to the card punch, to the disk file, or to the printer depending on the function specified on the control card. The formats for the printed output are discussed in this section. Punched records use the same format as the input data records discussed in Paragraph 4.3.2.

Five basic types of formats are used by CBMAM when data are written on the printer. These format types, their use, and sample outputs are presented in the following paragraphs. Each type begins with the same heading, listing the program name, CBMAM, the date and time of the program execution, and a page number.

```
//CBMAM     JOB HESS                                                00001000
//JOBLIB    DD DSN=COMBIMAN.LOADLIB,DISP=SHR                        00001100
//CBMAM     EXEC PGM=CBMAM                                          00001200
//FT02F001  DD DSN=COMBIMAN.ANTHDATA,DISP=SHR                       00001300
//FT05F001  DD DDNAME=SYSIN                                         00001400
//FT06F001  DD SYSOUT=A                                             00001500
//FT07F001  DD SYSOUT=B                                             00001600
//SYSUDUMP  DD SYSOUT=A                                             00001700
//SYSIN     DD *                                                    00001800


            CBMAM FUNCTION CONTROL CARDS AND
               MEMBER DEFINITION DATA


/*                                                                  00001900
//
```

Figure 91. Job Control Cards to Execute CBMAM.

```
//FT02F001 DD DSN=COMBIMAN.ANTHDATA,UNIT=DISK,DISP=(NEW,CATLG),     00001300
//            VOL=SER=DISK01,SPACE=(248,2000),                      00001310
//            DCB=(BLKSIZE=248,LRECL=248,RECFM=FB)                  00001320
```

Figure 92. FT02 DD Card to Allocate Space for COMBIMAN.ANTHDTA and Execute CBMVM.

The first type of output is generated by the INITIALIZE, PUNCH, COMPRESS, DELETE, and END functions. The output indicates the beginning and end of processing associated with the specified function. For the COMPRESS function, additional messages which indicate that a particular member is or is not moved in the process of compressing used space are printed. An example of this format for the COMPRESS function is shown in Figure 93.

The second type of output is generated by the PRINT or PUNCH functions when the +PRT or +PCH control cards are supplied with a blank membername field. This causes the program to list the index of the Data Base, which contains the location and type of each member. This information is printed in the following format:

```
nn.) membername, EXTENT = (nl, n2), TYPE = tt,
   nv VARIABLES, nc COMB OF INDEP, nd DEPENDENT,
   np PERCENTILES, r-membername REFERENCED SURVEY.
```

where:

nn	is the record number of its identification record within the directory.
nl	is the location of the first record of the data which defines this member.
n2	is the location of the last record of the data which defines this member.
tt	is the type code (0 or 1).
nv	is the total number of anthropometric variables defined for the member.
nc	is the number of combination of independent variables.
nd	is the number of dependent variables.
np	is the number of percentiles. Note: np=0 if tt=0.
r-membername	is the name of the referenced regression member. Note: r-membername is blank if tt=0.

```
CBMAM --- ANTHROPOMETRIC SURVEY DATA BASE MAINTENANCE PROGRAM            2/29/80  13.52.36  PAGE  14

CBM300I  +CMP R67 USAF
CBM335I  R67 USAF WAS IN PLACE.
CBM335I  67 USAF  WAS IN PLACE.
CBM336I  COMPRESS FINISHED.
CBM399I  PROGRAM END.
```

Figure 93. A Sample Output of the +CMP Function.

This information was originally supplied to the Data Base on the +ADD control card. A sample output of the PRINT function is shown in Figure 94.

The third type of output is generated by the DUMP ANTHROPOMETRIC DATA BASE function. This function is used primarily by systems programmers to locate causes of I/O (Input/Output) errors on the Data Base. For the member specified on the +DMP Control Card, a directory or index information is printed, using the output format previously described for the +PRT control card. Each record associated with the member is then printed in the following format:

```
RECORD nnn + = + (record in EBCDIC)                  + = +
  + = + (record in hexadecimal)                      + = +
  + = + (remainder of record in hexadecimal)         + = +
```

where nnn is the location of the record in the Data Base. The record is printed in EBCDIC using a 25A4 format and in hexadecimal using a 10Z8 format. An example of the DUMP function printout is shown in Figure 95.

The fourth output format is used by the CHECK, ADD, and PRINT functions when a type 0, or regression member is specified. The program CBMAM reads the control card and checks it for errors, and the information obtained from the control card is reformatted and written out to the printer. Following the control card information, each Variable Definitioin Card is printed. The format used to print the Variable Definition Card is as follows:

nn.) <u>variablename</u>, INDEP VBLS (MASS=<u>ns</u>, LENGTH=<u>ns</u>), DEP VBL=<u>ns</u>, UNIT OF MEASUREMENT=<u>uu</u>

```
CBMAM --- ANTHROPOMETRIC SURVEY DATA BASE MAINTENANCE PROGRAM              2/29/80   13.55. 0  PAGE   1

CBM3001 +PRT              0
                 20.) 67 USAF , EXTENT=(  63,   80), TYPE= 1, 17 VARIABLES, 24 COMB OF INDEP, 12 DEPENDENT, 25 PERCENTILES,
                              R67 USAF REFERENCED SURVEY.
                 21.) R67 USAF, EXTENT=(  22,   62), TYPE= 0, 17 VARIABLES, 24 COMB OF INDEP, 12 DEPENDENT,  0 PERCENTILES,
                                   REFERENCED SURVEY.
```

Figure 94. A Sample Output of the +PRT Function.

```
CSMAM --- ANTHROPOMETRIC SURVEY DATA BASE MAINTENANCE PROGRAM                2/29/80   13.55. 0  PAGE   6

RECORO    28+=+   GSHOULOR-ELB LGTH              AIN                                                      +=+
               +=+                                                                                        +=+
               +=+                                              +=+
+=+0000007E2C806E403C40960C503C24003C7E3C8000000000000000000000000000000000000001C905404000000000000000000000000000000000000000000+=+
+=+00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
RECORO    29+=+   HELBOW-GRIP LGTH          A     IN                                                      +=+
               +=+                                                                                        +=+
               +=+                                              +=+
+=+00000008C503C2D6E660C709C9D7403C7E3C8400000C0000000001 0C000000C9D54040000000000000000000000000000000000000000000000000000000000+=+
+=+00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
RECORO    30+=+   ITHUMB-TIP REACH          A     IN                                                      +=+
               +=+                                                                                        +=+
               +=+                                              +=+
+=+000000009E3C8E4D4C260E3C9D74039C5C1C3C84000000000000000100000000C9D540400000000000000000000000000000000000000000000000000000000+=+
+=+00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
RECORO    31+=+    BIACROMIAL BRDTH              AIN                                                      +=+
               +=+                                                                                        +=+
               +=+                                              +=+
+=+0000000AC2C9C1C3090604C9C10340C2D9C4E3C800000000000000000000000000000000000001C905404000000000000000000000000000000000000000000+=+
+=+00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
RECORD    32+=+   .BIOELTIOO BROTH      A         IN                                                      +=+
               +=+                                                                                        +=+
               +=+                                              +=+
+=+0000008C2C9C4C503E3C906C440C2D9C4E3C8400000000100000000000000C905404000000000000000000000000000000000000000000000000000000000+=+
+=+00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
RECORO    33+=+   <HIP BREAOTH                   AIN                                                      +=+
               +=+                                                                                        +=+
               +=+                                              +=+
+=+0000000CC8C90740C209C5C1C4E3C8404040404000000000000000000000000000000000000001C905404000000000000000000000000000000000000000000+=+
+=+00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
RECORC    34+=+   (HIP BREAOTH/SITT     A         IN                                                      +=+
               +=+                                                                                        +=+
               +=+                                              +=+
+=+00000000C8C90740C209C5C1C4E3C861E2C9E3E30000000100000000000000000000000C90540400000000000000000000000000000000000000000000000000+=+
+=+00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+00000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
+=+000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
```

Figure 95. A Sample Output of the +DMP Function.

where:

nn	is the variable number
variablename	is the 16 character name of the variable
ns	0 means NO; 1 means Yes
uu	is the unit of measurement assigned to the variable: IN, CM, MM, LB, or KG.

After the variable definition data, the regression data for each combination of independent variables are printed. The format is shown in Figure 96. The terms are defined as follows:

n1	is the variable number for the mass-related variable
mass name	is the variable name for the mass-related variable
n2	is the variable number for the length-related variable
length name	is the variable name for the length-related variable
$bb.bbb_1, bb.bbb_2$	is the slope used to predict (1) length variable from mass variable, and (2) mass variable from length variable
$cc.ccc_1, cc.ccc_2$	is the constant used to predict (1) length variable from mass variable, and (2) mass variable from length variable
$ss.sss_1, ss.sss_2$	is the standard error of the estimate of the equations
nd_1 - nd_{ndep}	are the variable numbers for the dependent variables
$depname_1$ - $depname_{ndep}$	are the variable names for the dependent variables
$bb.bbbb^1_1$ - $bb.bbbbb^1_{ndep}$	is the slope for the mass variable when predicting dependent $variable_i$, where i=1, ndep

INDEPENDENT VARIABLES (MASS & LENGTH)		DEPENDENT VARIABLE		REGRESSION COEFFICIENTS (B1, B2, CNST)			
n1 mass name	n2 length name	SIMPLE REGR (B1, CNST, SE) -		LENGTH FROM MASS	$\underline{bb.bbb}_1$	$\underline{cc.ccc}_1$	$\underline{ss.sss}_1$
				MASS FROM LENGTH	$\underline{bb.bbb}_2$	$\underline{cc.ccc}_2$	$\underline{ss.sss}_2$
		$\underline{nd}_1$	$\underline{\text{dep vbl name}}_1$	$\underline{bb.bbbbb}^1_1$	$\underline{bb.bbbbb}^2_1$	$\underline{cc.ccccc}_1$	
		⋮	⋮	⋮	⋮	⋮	
		$\underline{nd}_{ndep}$	$\underline{\text{dep vbl name}}_{ndep}$	$\underline{bb.bbbbb}^1_{ndep}$	$\underline{bb.bbbbb}^2_{ndep}$	$\underline{cc.ccccc}_{ndep}$	

Figure 96. Output Format Used for Type 0 Regression Data.

$bb.bbbbb^2_1$ - $bb.bbbbb^2_{ndep}$	is the slope for the length variable when predicting dependent $variable_i$, where i=1, ndep
$cc.ccccc_1$ - $cc.ccccc_{ndep}$	is the constant for the multiple regression equation to predict dependent $variable_i$, where i=1, ndep.

An example of the output in the fourth format for the +ADD control card is shown in Figure 97 and 98.

The fifth output format is also used by the CHECK, ADD and PRINT functions, but only when the type code is 1, indicating a survey member. The program CBMAM reads the control card and checks it for errors, and reformats and prints the information on the card relevant to the number of records written to the Data Base. Following the control card information, the percentile names (such as 1, 2, 3, 50, 95, etc.) for the member are printed as part of a subheading. A maximum of 10 percentile names are printed on one line. The survey data are then printed in the following format:

$\underline{nn}$.) $\underline{variablename}$ $\underline{uu}$ $\underline{mmm.mm}$ $\underline{ss.sss}$ $\underline{ppp.pp_1}$ ... $\underline{ppp.pp_{10}}$

$\underline{ppp.pp_{11}}$ ... $\underline{ppp.pp_{20}}$

$\underline{ppp.pp_{21}}$ ... $\underline{ppp.pp_{npct}}$

where

nn	is the variable number
variablename	is the name of the anthropometric variable
uu	is the specified unit of measurement for the variable
mmm.mm	is the mean value for the variable
ss.sss	is the standard deviation for the variable
$ppp.pp_1$- $ppp.pp_{npct}$	are the percentile values associated with the percentile names for the anthropometric variables

An example of this fifth format is shown in Figure 99.

```
CBMAM --- ANTHROPOMETRIC SURVEY DATA BASE MAINTENANCE PROGRAM          4/15/81    9.56.17   PAGE   2

CBM3C01 +ADD R67 USAF    0  17  24  12    0
CBM3131 MEMBER R67 USAF  IS TYPE  0 AND CONTAINS 17 ANTHROPOMETRIC VARIABLE NAMES.
CBM3141 MEMBER ALSO CONTAINS 24 ADDITIONAL RECORDS, EACH CONTAINING THE REGRESSION COEFFICIENTS FOR 12 DEPENDENT VARIABLES.
                 1.) WEIGHT            , INDEP VBLS(MASS= 1, LENGTH= 0), DEP VBL= 1, UNIT OF MEASUREMENT= LB
                 2.) SITTING HEIGHT    , INDEP VBLS(MASS= 0, LENGTH= 1), DEP VBL= 1, UNIT OF MEASUREMENT= IN
                 3.) EYE HGT/SITTING   , INDEP VBLS(MASS= 0, LENGTH= 1), DEP VBL= 0, UNIT OF MEASUREMENT= IN
                 4.) ACROMION HGT/SIT, INDEP VBLS(MASS= 0, LENGTH= 0), DEP VBL= 1, UNIT OF MEASUREMENT= IN
                 5.) KNEE HGT/SITTING, INDEP VBLS(MASS= 0, LENGTH= 1), DEP VBL= 1, UNIT OF MEASUREMENT= IN
                 6.) BUTTOCK-KNE LGTH, INDEP VBLS(MASS= 0, LENGTH= 1), DEP VBL= 1, UNIT OF MEASUREMENT= IN
                 7.) SHOULDR-ELB LGTH, INDEP VBLS(MASS= 0, LENGTH= 0), DEP VBL= 1, UNIT OF MEASUREMENT= IN
                 8.) ELBOW-GRIP LGTH , INDEP VBLS(MASS= 0, LENGTH= 1), DEP VBL= 0, UNIT OF MEASUREMENT= IN
                 9.) THUMB-TIP REACH , INDEP VBLS(MASS= 0, LENGTH= 1), DEP VBL= 0, UNIT OF MEASUREMENT= IN
                10.) BIACROMIAL BRDTH, INDEP VBLS(MASS= 0, LENGTH= 0), DEP VBL= 1, UNIT OF MEASUREMENT= IN
                11.) BIDELTIOD BRDTH , INDEP VBLS(MASS= 1, LENGTH= 0), DEP VBL= 0, UNIT OF MEASUREMENT= IN
                12.) HIP BREADTH     , INDEP VBLS(MASS= 0, LENGTH= 0), DEP VBL= 1, UNIT OF MEASUREMENT= IN
                13.) HIP BREADTH/SITT, INDEP VBLS(MASS= 1, LENGTH= 0), DEP VBL= 0, UNIT OF MEASUREMENT= IN
                14.) CHEST DEPTH     , INDEP VBLS(MASS= 1, LENGTH= 0), DEP VBL= 1, UNIT OF MEASUREMENT= IN
                15.) FOOT LENGTH     , INDEP VBLS(MASS= 0, LENGTH= 0), DEP VBL= 1, UNIT OF MEASUREMENT= IN
                16.) HAND LENGTH     , INDEP VBLS(MASS= 0, LENGTH= 0), DEP VBL= 1, UNIT OF MEASUREMENT= IN
                17.) ELBOW-WRIST LGTH, INDEP VBLS(MASS= 0, LENGTH= 0), DEP VBL= 1, UNIT OF MEASUREMENT= IN

                INDEPENDENT VARIABLES (MASS & LENGTH)      DEPENDENT VARIABLE      REGRESSION COEFFICIENTS (B1, B2, CNST)

                1 WEIGHT               2 SITTING HEIGHT    SIMPLE REGR (B1,CNST,SE) - LENGTH FROM MASS       0.027  32.053   1.112
                                                                                 MASS        LENGTH    7.845-114.208  19.059
                                                           1 WEIGHT              1.00000   0.0        0.0
                                                           2 SITTING HEIGHT      0.0       1.00000    0.0
                                                           4 ACROMION HGT/SIT    0.0       0.73100   -2.77952
                                                           5 KNEE HGT/SITTING    0.0       0.40400    7.13384
                                                           6 BUTTOCK-KNE LGTH    0.0       0.33300   11.56690
                                                           7 SHOULDR-ELB LGTH    0.0       0.24700    5.09054
                                                          10 BIACROMIAL BRDTH    0.01317   0.11050    9.69417
                                                          12 HIP BREADTH         0.02792   0.00430    8.87957
                                                          14 CHEST DEPTH         0.03130  -0.16650   10.32958
                                                          15 FOOT LENGTH         0.00697   0.12480    4.85468
                                                          16 HAND LENGTH         0.0       0.11700    3.23228
                                                          17 ELBOW-WRIST LGTH    0.0       0.19300    4.72834
```

Figure 97. A Sample Output of the +ADD Function for Type 1 Member.

```
CBMAM --- ANTHROPOMETRIC SURVEY DATA BASE MAINTENANCE PROGRAM           4/15/81    9.56.17   PAGE    3

        1 WEIGHT            3 EYE HGT/SITTING  SIMPLE REGR (B1,CNST,SE) - LENGTH FROM MASS      0.023  27.899    1.081
                                                                    MASS        LENGTH    7.457 -64.028   19.522
                                           1 WEIGHT            1.00000    0.0          0.0
                                           2 SITTING HEIGHT    0.0        0.97900      5.48424
                                           4 ACROMION HGT/SIT  0.0        0.73700      0.55118
                                           5 KNEE HGT/SITTING  0.0        0.40300      9.11415
                                           6 BUTTOCK-KNE LGTH  0.0        0.34900     12.66139
                                           7 SHOULDR-ELB LGTH  0.0        0.26000      5.86613
                                          10 BIACROMIAL BRDTH  0.01416    0.08570     10.84526
                                          12 HIP BREADTH       0.02782    0.00930      8.75802
                                          14 CHEST DEPTH       0.03049   -0.15870      9.41976
                                          15 FOOT LENGTH       0.00752    0.12150      5.46532
                                          16 HAND LENGTH       0.0        0.11300      3.92125
                                          17 ELBOW-WRIST LGTH  0.0        0.17300      6.29526
        1 WEIGHT            5 KNEE HGT/SITTING SIMPLE REGR (B1,CNST,SE) - LENGTH FROM MASS      0.025  17.666    0.827
                                                                    MASS        LENGTH   11.762 -84.611   18.054
                                           1 WEIGHT            1.00000    0.0          0.0
                                           2 SITTING HEIGHT    0.0        0.65600     22.28342
                                           4 ACROMION HGT/SIT  0.0        0.51000     12.83855
                                           5 KNEE HGT/SITTING  0.0        1.00000      0.0
                                           6 BUTTOCK-KNE LGTH  0.0        0.85100      5.09842
                                           7 SHOULDR-ELB LGTH  0.0        0.51600      2.82283
                                          10 BIACROMIAL BRDTH  0.01256    0.14420     10.68774
                                          12 HIP BREADTH       0.02823   -0.00810      9.16118
                                          14 CHEST DEPTH       0.03019   -0.13470      7.37230
                                          15 FOOT LENGTH       0.00303    0.29470      3.64651
                                          16 HAND LENGTH       0.0        0.21500      2.80314
                                          17 ELBOW-WRIST LGTH  0.0        0.44300      2.08267
        1 WEIGHT            6 BUTTOCK-KNE LGTH SIMPLE REGR (B1,CNST,SE) - LENGTH FROM MASS      0.032  18.299    0.821
                                                                    MASS        LENGTH   12.813-131.085   16.540
                                           1 WEIGHT            1.00000    0.0          0.0
                                           2 SITTING HEIGHT    0.0        0.46000     25.74403
                                           4 ACROMION HGT/SIT  0.0        0.35800     15.52359
                                           5 KNEE HGT/SITTING  0.0        0.72500      4.71259
                                           6 BUTTOCK-KNE LGTH  0.0        1.00000      0.0
                                           7 SHOULDR-ELB LGTH  0.0        0.44200      3.64172
                                          10 BIACROMIAL BRDTH  0.01581    0.00970     13.06010
                                          12 HIP BREADTH       0.02673    0.04120      8.26378
                                          14 CHEST DEPTH       0.02938   -0.07950      6.44568
                                          15 FOOT LENGTH       0.00338    0.21920      4.84350
                                          16 HAND LENGTH       0.0        0.16500      3.59842
                                          17 ELBOW-WRIST LGTH  0.0        0.32700      4.03149
```

Figure 98. A Sample Output of the +ADD Function for Type 1 Member.

CB43001 +ADD 67 USAF 1 17 24 12 25 R67 USAF
CB43131 MEMBER 67 USAF IS TYPE 1 AND CONTAINS 17 ANTHROPOMETRIC VARIABLE NAMES.

NO.	VARIABLE NAME	UNIT	MEAN	STDV	PERCENTILES									
					1	2	3	5	10	15	20	25	30	35
					40	45	50	55	60	65	70	75	80	85
					90	95	97	98	99					
1.)	WEIGHT	LB	173.61	21.435	127.58	132.63	135.82	140.15	146.89	151.53	155.27	158.56	161.56	164.37
					167.08	169.74	172.42	175.13	177.92	180.84	183.97	187.41	191.32	195.91
					201.83	210.76	216.62	220.94	227.73					
2.1	SITTING HEIGHT	IN	36.69	1.250	33.94	34.24	34.44	34.70	35.11	35.39	35.62	35.82	36.00	36.17
					36.33	36.49	36.65	36.81	36.98	37.15	37.33	37.53	37.75	38.01
					38.33	38.80	39.10	39.31	39.62					
3.)	EYE HGT/SITTING	IN	31.87	1.187	29.17	29.50	29.71	29.98	30.38	30.65	30.87	31.06	31.23	31.38
					31.53	31.68	31.83	31.98	32.13	32.29	32.46	32.65	32.86	33.11
					33.43	33.90	34.21	34.43	34.78					
4.)	ACROMION HGT/SIT	IN	24.04	1.123	21.42	21.77	21.97	22.24	22.63	22.89	23.10	23.27	23.43	23.58
					23.73	23.87	24.01	24.15	24.30	24.45	24.61	24.79	24.99	25.22
					25.51	25.94	26.20	26.39	26.66					
5.)	KNEE HGT/SITTING	IN	21.96	0.980	19.73	19.98	20.15	20.37	20.71	20.95	21.13	21.29	21.43	21.57
					21.69	21.82	21.94	22.06	22.19	22.31	22.45	22.60	22.77	22.96
					23.22	23.60	23.86	24.05	24.36					
6.)	BUTTOCK-KNE LGTH	IN	23.78	1.062	21.38	21.65	21.83	22.07	22.44	22.69	22.89	23.06	23.22	23.36
					23.50	23.63	23.76	23.89	24.02	24.16	24.31	24.47	24.65	24.86
					25.14	25.57	25.87	26.10	26.48					
7.1	SHOULDR-ELB LGTH	IN	14.15	0.674	12.65	12.81	12.91	13.06	13.29	13.45	13.57	13.68	13.79	13.88
					13.97	14.06	14.14	14.23	14.32	14.41	14.51	14.61	14.73	14.86
					15.03	15.28	15.44	15.55	15.73					
8.1	ELBOW-GRIP LGTH	IN	13.86	0.636	12.47	12.61	12.70	12.83	13.04	13.19	13.31	13.42	13.51	13.60
					13.69	13.77	13.85	13.93	14.01	14.10	14.19	14.29	14.40	14.52
					14.69	14.93	15.09	15.21	15.40					
9.1	THUMB-TIP REACH	IN	31.62	1.565	28.04	28.46	28.72	29.08	29.64	30.01	30.30	30.56	30.79	31.00
					31.20	31.39	31.58	31.78	31.98	32.18	32.40	32.64	32.91	33.22
					33.64	34.27	34.69	35.02	35.55					
10.1	BIACROMIAL BRDTH	IN	16.03	0.764	14.18	14.41	14.56	14.75	15.05	15.25	15.41	15.54	15.66	15.76
					15.86	15.96	16.05	16.14	16.24	16.33	16.43	16.54	16.66	16.80
					16.98	17.26	17.44	17.58	17.82					
11.1	BIDELTIOD BRDTH	IN	18.99	1.008	16.67	16.96	17.14	17.37	17.72	17.95	18.14	18.30	18.44	18.58
					18.71	18.84	18.96	19.09	19.22	19.36	19.51	19.67	19.85	20.05
					20.32	20.71	20.97	21.15	21.42					
12.1	HIP BREADTH	IN	13.88	0.742	12.21	12.41	12.54	12.71	12.97	13.14	13.28	13.39	13.50	13.59
					13.68	13.77	13.86	13.95	14.04	14.13	14.23	14.34	14.47	14.62
					14.82	15.15	15.37	15.55	15.84					
13.1	HIP BREADTH/SITT	IN	14.88	0.906	12.86	13.10	13.25	13.45	13.75	13.96	14.12	14.26	14.39	14.51
					14.62	14.73	14.84	14.95	15.06	15.18	15.31	15.45	15.61	15.80
					16.05	16.44	16.70	16.90	17.23					
14.)	CHEST DEPTH	IN	9.65	0.758	7.98	8.14	8.25	8.41	8.67	8.85	9.00	9.13	9.25	9.36
					9.46	9.56	9.65	9.75	9.85	9.94	10.05	10.16	10.29	10.43
					10.62	10.90	11.10	11.24	11.49					
15.)	FOOT LENGTH	IN	10.64	0.468	9.57	9.70	9.79	9.89	10.06	10.17	10.25	10.33	10.39	10.46
					10.52	10.57	10.63	10.69	10.75	10.81	10.86	10.95	11.03	11.13
					11.25	11.44	11.56	11.65	11.80					

Figure 99. A Sample Output of the +ADD Function for Type 0 Member.

4.4 PROGRAM MESSAGES INCLUDING ERROR CORRECTION

The program CBMAM prints out both information and action related messages. The message format is as follows:

CBM3nni   message text

where:

nn	is the message number
i	identifies the action code (I=informational, A=action to be performed), and
message text	is the text of the message.

Unless otherwise noted, all messages are issued by the routine CBMAM.

CBM300I Control card image (e.g. +ADD, +PRT, etc.)

- Reason: The user submitted a control card.
- System Action: Continues processing.
- User Action: None.

CBM301A Operation - UNKNOWN OPERATION.

- Reason: The operation on the control card (shown in the previous CBM300I Message) is unknown.
- System Action: The control card is ignored.
- User Action: Correct card, using a valid operation, and resubmit.

CBM302I INITIALIZED.

- Reason: The user requested to initialize the Anthropometric data base using the INITIALIZE ANTHROPOMETRIC DATA BASE Function (+INT).
- System Action: The Data Base is initialized.
- User Action: None.

CBM303A NO NAME GIVEN; operation IGNORED.

- Reason: The operation specified on the control card requires a membername; but no name was supplied.
- System Action: The control card and subsequent data, if any, are ignored.
- User Action: Correct the card, adding the appropriate additional information as required in the definition of the specific operation, and resubmit.

CBM304A TYPE SPECIFICATION INVALID FOR MEMBER membername.

Reason: An invalid type code, that is, a type code other than 0 or 1, was given for the specified member.

System Action: Control card, and any subsequent data, are ignored.

User Action: Correct code and resubmit.

CBM305A NUMBER OF ANTHROPOMETRIC DIMENSIONS INVALID FOR MEMBER membername.

Reason: The number of anthropometric dimensions specified for the given member on either the +ADD or +CHK control card was either less than one or greater than 45.

System Action: Control card and any subsequent data are ignored.

User Action: Correct value and resubmit.

CBM306A NUMBER OF COMBINATIONS OF INDEPENDENT VARIABLES INVALID FOR MEMBER membername

Reason: The number of combinations of independent variables (the product of the number of mass related variables and the number of length related variables) for the +ADD or +CHK control card is less than one or greater than 50, for the specified member.

System Action: The control card and any subsequent data are ignored.

User Action: Correct the card and resubmit.

CBM307A NUMBER OF DEPENDENT VARIABLES INVALID FOR MEMBER membername

Reason: The number of dependent variables specified on the +ADD or +CHK control card was less than one or greater than 30 for the indicated member.

System Action: The control card and any subsequent data are ignored.

User Action: Correct the card and resubmit.

CBM308A NUMBER OF PERCENTILES INVALID FOR MEMBER membername

Reason: The number of percentiles specified on the +ADD or +CHK control card was less than one or greater than 30 for the indicated member.

System Action: The control card and subsequent data are ignored.

User Action: Correct the number and resubmit.

CBM309A ILLEGAL CONTROL CARD FOR MEMBER membername DUE TO nn ERRORS.

Reason:	Control card format invalid. The system found nn errors.
System Action:	Control card and subsequent data cards are ignored.
User Action:	Correct the card and resubmit.

CBM310A INSUFFICIENT SPACE REMAINING TO ADD MEMBER membername.

Reason:	The Data Base does not have sufficient continuous space to add the specified member.
System Action:	The member is not added to the data base.
User Action:	Run the program CBMAM with the +CMP control card, followed by the request to add the specified member. If the CBM310A message reappears, members will have to be deleted (using the +DEL function) before adding new member.

CBM311A DIRECTORY IS FULL, CANNOT ADD membername.

Reason:	The Data Base directory, which contains the location of each member within the file, can hold a maximum of 20 entries.
System Action:	The member is not added to the Data Base.
User Action:	Delete a member and add the new member.

CBM312A MEMBER membername IS NOT FOUND IN THE DIRECTORY.

Reason:	The type 0 member membername which was referenced by the type 1 member is not in the directory.
System Action:	The control card and data are ignored.
User Action:	Check that the type 0 member was specified.

CBM313I MEMBER, membername IS TYPE tt AND CONTAINS nn ANTHROPOMETRIC VARIABLE NAMES.

Reason:	The +ADD or +CHK control card has been read in for the specified member, and the type field and the number of variables have been accepted.
System Action:	Program continues execution.
User Action:	None.

CBM314I MEMBER ALSO CONTAINS nn ADDITIONAL RECORDS, EACH CONTAINING THE REGRESSION COEFFICIENTS FOR mm DEPENDENT VARIABLES.

Reason: Message is printed for +ADD or +CHK control card for type 0 members. It provides information on the number of additional records associated with the previously specified member.

System Action: Program continues execution.

User Action: None.

CBM315A VARIABLE variablename1 HAS THE SAME NUMBER AS VARIABLE variablename2.

Reason: Each variable entered as part of a type 0 or type 1 member must have a unique number.

System Action: Record which defines variablename1 is flagged as containing an error. Member is not added.

User Action: Correct the number and resubmit.

CBM316A variable name USED IN VARIABLES n1 AND n2.

Reason: Each variable number must have a unique variable name.

System Action: Record which contains variable number n2 is flagged as containing an error. Member is not added.

User Action: Correct record and resubmit.

CBM317A variable name IS NEITHER DEPENDENT OR INDEPENDENT.

Reason: An anthropometric variable must be defined as either dependent, that is one necessary for the creation of the link system of the model, or independent, that is a variable highly correlated to body segment mass or body segment length. This variable has not been flagged as either.

System Action: The record is flagged as containing an error, and the member is not added to the data base.

User Action: Punch a "1" in either column 16, 30, or 34, depending on the type of variable and resubmit.

CBM318A variablename IS INDEPENDENT VARIABLE FOR BOTH MASS AND LENGTH.

Reason: An anthropometric variable may be an independent variable correlated to either mass or length, but not to both.

System Action: The record is flagged as containing an error, and the member is not added to the Data Base.

User Action: Delete the entry "1" from either column 26 or 30 and resubmit.

CBM319A MEMBER membername CONTAINS TOO MANY INDEPENDENT VARIABLES.

Reason: The number of combinations of independent variables (number of mass variables x number of length variables) encountered must be equal to the number of combinations specified on the +ADD or +CHK control card.

System Action: Member is not added to Data Base.

User Action: Verify the totals, make the appropriate corrections, and resubmit.

CBM320A MEMBER membername CONTAINS TOO MANY DEPENDENT VARIABLES.

Reason: The number of dependent variables encountered must be equal to the number of dependent variables specified on the +ADD or +CHK control card.

System Action: Member is not added to the Data Base.

User Action: Verify the total, make appropriate corrections, and resubmit.

CBM321A UNIT OF MEASUREMENT, uu FOR VARIABLE variablename IS NOT PERMISSIBLE.

Reason: Valid units of measurement are IN, CM, MM, LB, and KG.

System Action: The record is flagged and the member is not added to the Data Base.

User Action: Supply a valid unit of measurement, and resubmit.

CBM322A DATA CARD IMAGE multiple regression coefficient card image OUT OF SEQUENCE.

Reason: For each combination of independent variables, a total of NDEP+1 records must be supplied, each beginning with the same two variable numbers specifying the mass and length variable.

System Action: The record is flagged and the member is not added to the Data Base.

User Action: Correct the error and resubmit.

CBM323A VARIABLE variable name IS NOT AN INDEPENDENT VARIABLE PERTAINING TO MASS.

Reason: The variable number supplied in column 1-3 of the regression data cards should correspond to a variable name defined as a mass related independent variable on one of the anthropometric variable definition cards. (See Figure 89)

System Action: The record is flagged and the member is not added to the Data Base.

User Action: Correct the error and resubmit.

CBM324A VARIABLE variablename IS NOT AN INDEPENDENT VARIABLE PERTAINING TO LENGTH.

Reason: The variable number supplied in column 4-6 of the regression definition data cards should correspond to a variable name defined as a length related independent variable on one of the anthropometric variable definition cards. (See Figure 89)

System Action: The record is flagged and the member is not added to the Data Base.

User Action: Correct the error and resubmit.

CBM325A VARIABLE variablename IS NOT A DEPENDENT VARIABLE.

Reason: The variable number supplied in columns 7-9 of the multiple regression data definition cards should correspond to a variable name defined as a dependent variable on one of the anthropometric variable definition cards. (See Figure 89)

System Action: The record is flagged and the member is not added to the Data Base.

User Action: Correct the error and resubmit.

CBM326A VARIABLE nn OUT OF SEQUENCE.

Reason: For a type 1 member definition, the survey definition cards must contain the variable numbers in ascending order.

System Action: The record is flagged and the member is not added to the Data Base.

User Action: Make necessary corrections and resubmit.

CBM327A variablename IN MEMBER survey membername DOES NOT CORRESPOND TO VARIABLE nn IN regression membername.

Reason: The variable names and numbers in the type 1 member survey membername should correspond exactly to the names and numbers in the referenced type 0 member regression membername.

System Action: The record in the type 1 member definition is flagged and the member is not added to the data base.

User Action: Verify the survey definition variable number and name against the regression or type 0 member, make necessary corrections, and resubmit.

CBM328A ANTHROPOMETRIC DIMENSION LT OR EQ TO ZERO.

Reason: Dimensions supplied in the survey member definition cards must be positive real numbers.

System Action: The record is flagged and the member is not added.

User Action: Correct and resubmit.

CBM329I MEMBER regression membername, WITH nn ANTHROPOMETRIC VARIABLES AND nn_1 X nn_2 SETS OF REGRESSION EQUATIONS, HAS BEEN ADDED.

Reason: The type 0 member is added to the Data Base.

System Action: The member is added to the Data Base.

User Action: None.

CBM330I MEMBER survey membername, WITH nn ANTHROPOMETRIC VARIABLES AND nn_1 PERCENTILES, AND REFERENCING SURVEY regression membername HAS BEEN ADDED.

Reason: The type 1 member is added to the Data Base.

System Action: The member is added to the Data Base.

User Action: None.

CBM331A membername HAS NOT BEEN ADDED DUE TO nnn ERRORS.

Reason: After checking the member definition, nnn syntax errors were found.

System Action: The member is not added to the Data Base.

User Action: Correct the errors, and resubmit.

CBM332A MEMBER membername CHECKED - nnnnn ERRORS.

Reason: After checking the member definition, nnnnn syntax errors were found.

System Action: None.

User Action: Correct the errors and resubmit.

CBM333I MEMBER membername DELETED.

Reason:	User requested +DEL function caused a member to be deleted from the Data Base.
System Action:	Member deleted from Data Base.
User Action:	None.

CBM334I membername NOW IN PLACE.

Reason:	User requested +CMP function caused member to be moved within Data Base, combining unused space.
System Action:	Directory index in data base updated.
User Action:	None.

CBM335I membername WAS IN PLACE.

Reason:	User requested +CMP function and the system found that the member membername need not be moved.
System Action:	Compression of Data Base continues.
User Action:	None.

CBM336I COMPRESS FINISHED.

Reason:	Successful completion of +CMP function.
System Action:	Program execution continues.
User Action:	None.

CBM337I membername PUNCHED.

Reason:	User initiated +PCH function for member membername successfully completed.
System Action:	Punching is completed.
User Action:	None.

CBM339A END-OF-DATA.

Reason:	End of file found before END Program Control Card (+END) was found.
System Action:	Terminates job.
User Action:	Check that all control cards were processed.

CBM340A MEMBER membername ALREADY EXISTS.

Reason:	The user has tried to add an anthropometric member definition under a name that already exists in the Data Base.
System Action:	The control card is ignored.
User Action:	Use a new name and resubmit.

CBM341A DATA BASE IS NOT AN ANTHROPOMETRIC DATA BASE.

Reason:	First record of file does not contain "ANTH", the Anthropometric Data Base identificaton word.
System Action:	Terminates the program.
User Action:	Contact systems programmer.

CBM342A I/O ERROR ON RECORD nnnnn (INDEX).

Reason:	An I/O error has occurred in the directory of the Anthropometric Data Base.
System Action:	Terminates the program.
User Action:	Contact systems programmer.

CBM343A I/O ERROR ON RECORD nnnnn (DATA).

Reason:	An I/O error has occurred in a member definition on the Anthropometric Data Base.
System Action:	Terminates the program
User Action:	Contact systems programmer.

CBM399I PROGRAM END.

Reason:	The +END Control Card was encountered, or the end of input cards was encountered, or there was an I/O error.
System Action:	Terminates the program.
User Action:	Check that all control cards were accepted, and processed correctly.

SECTION 5

COMBIMAN CREW STATION DATA BASE MAINTENANCE PROGRAM (CBMCM)

The COMBIMAN system is an effective tool to analyze and evaluate crew stations. These crew stations may already be in use, or may exist only as an engineer's drawing. The best way to make these crew stations available to the man-model in the interactive graphics program CBM05 is to store the three dimensional coordinates of the panels and controls of the crew station on a Data Base accessed by CBM05. The program CBMCM is developed to assist the user to create and to maintain such a Crew Station Data Base. The data flow for the program CBMCM is shown in Figure 100.

The Crew Station Data Base contains definitions which describe the crew stations geometrically. Typical crew stations are aircraft cockpits, driver's area of an automobile, etc. To define a crew station, the user must supply the definition and 3-D coordinates of the vertices of the "panels" which make up the crew stations and controls found on and about the defined panels. Each crew station in the Data Base is called a "member", and is referenced by its membername.

5.1 AVAILABLE PROCESSING

The program CBMCM allows the user to create and maintain the Crew Station Data Base. Input supplied by the user, on 80 character computer cards or in card image format (80 character records) on a magnetic tape or any other device, is read into the program CBMCM and is processed according to the control card commands selected by the user. These commands allow the user to add or delete members, to print or punch existing members, or to list the contents of the Data Base and its directory. The program is also used to compress the members within the Data Base.

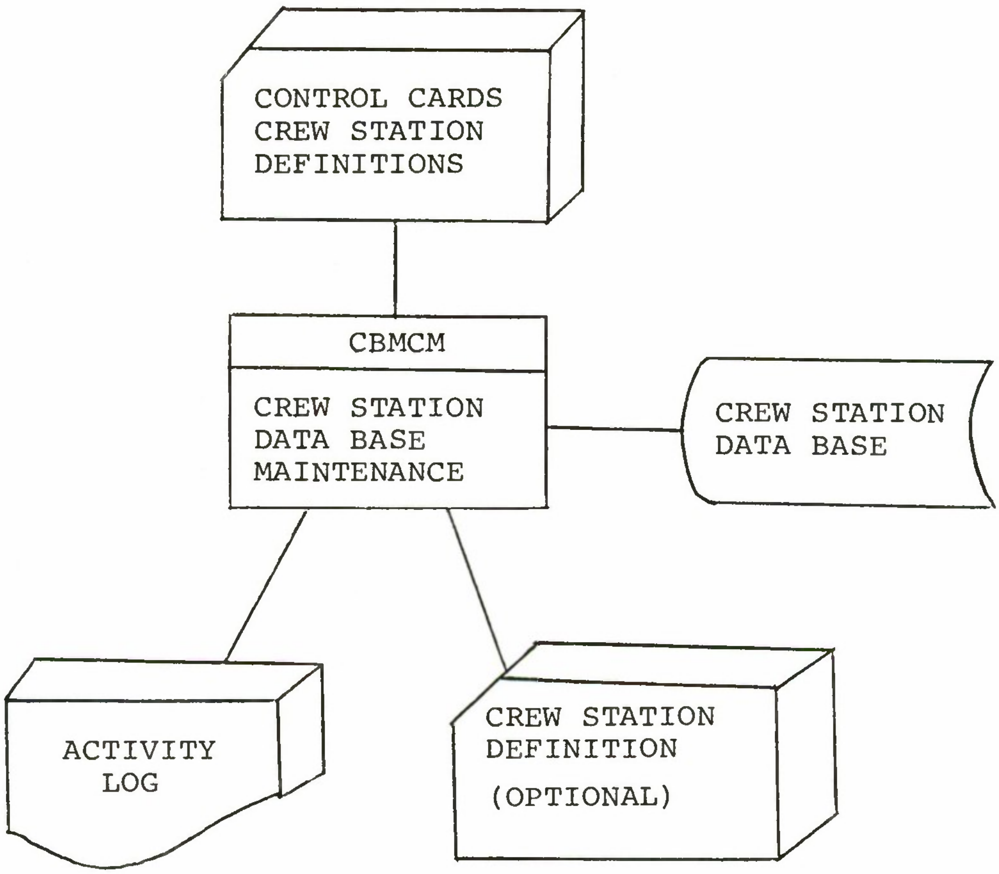


Figure 100. Data Flow for Program CBMCM.

The control cards for CBMCM may be input in any order with one exception. If the Data Base is created for the first time, or if it is reinitialized, the $INT (Initialize) control card must precede all other control cards and member definitions.

5.2 RESTRICTIONS AND LIMITATIONS

The Crew Station Data Base may contain up to 20 members. The sum of the record counts for all the members may not exceed 1979 records. Information on the number of members on the Data Base and their size may be obtained by using the $PRT control card, omitting reference to any membername. Membernames are limited to 8 alphanumeric characters. A member definition may contain a maximum of 300 panels and 300 controls. Additional limitations are described in Paragraph 5.3.2, "Processing Specifications."

5.3 HOW TO USE PROGRAM CBMCM

The example used to illustrate this program is based on the crew station in Figure 101, a seven-drawer desk. In modeling the desk, only the top, front side, and leg are defined. The other sides are not needed because they do not cause any physical or visual interference to the man-model seated at a desk.

5.3.1 Input Data Specification

Using the dimensions of the desk, and the origin as indicated in the figure, three dimensional coordinates are obtained for the various vertices of the panels and for the locations of the controls. The program CBMCM is set up to accept crew station definitions in any three dimensional cartesian coordinate system. The coordinate system for COMBIMAN

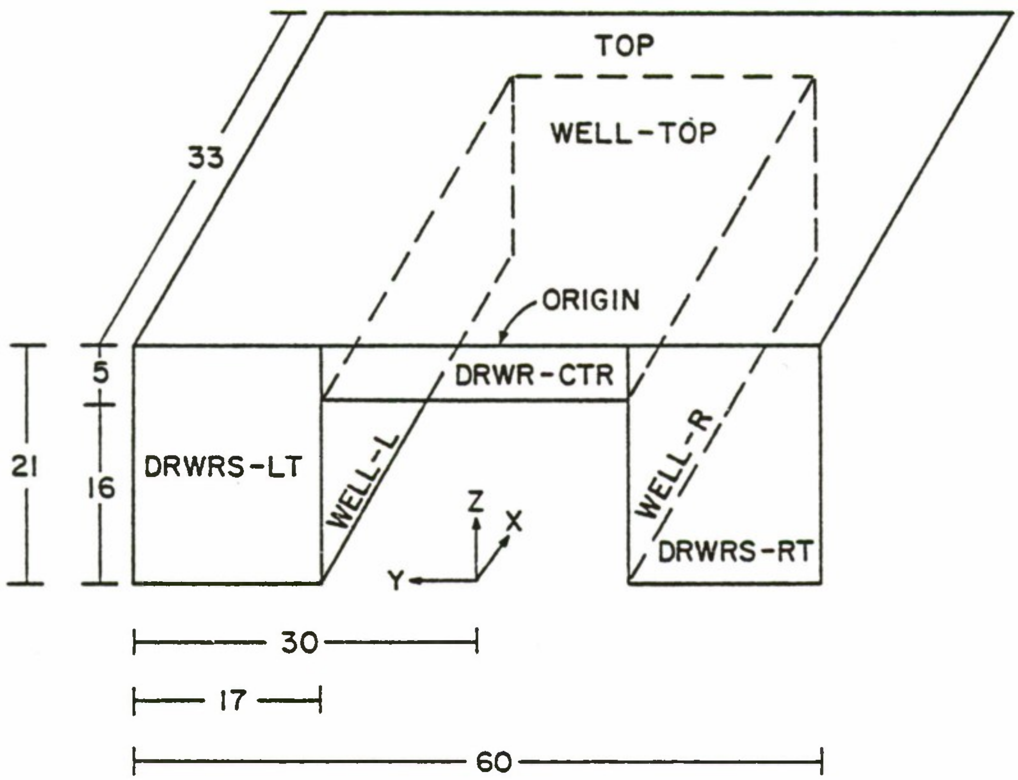


Figure 101. Sample Crew Station - DESK.

is a right handed system (positive x forward, positive y to the left, and positive z up). The user must supply the program CBMCM with the three-dimensional coordinates of the Seat Reference Point (SRP) with respect to the origin of the crew station's coordinate system. From these data, the program converts all input coordinates of the panels and controls to the coordinate system of the COMBIMAN.

Figure 102 shows an example of a typical Aircraft Coordinate system and its related COMBIMAN Coordinate system.

Panels for the crew station must have three to six vertices. Coordinate data for these vertices are entered into the program consecutively, going either clockwise or counterclockwise along the perimeter of the panel. Some examples of valid and invalid panels are shown in Figure 103. A total of seven panels make up the DESK in the example. Each panel has four vertices, and is rectangular in shape. The coordinates of the vertices are shown in Figures 104 and 105. If a panel has more than 6 vertices, or has a curved edge so that more than 6 vertices are required to approximate the curve, the panel must be subdivided into multiple panels of three to six vertices.

Controls are defined by either absolute or relative coordinates. If the control is not placed on a panel, it must be defined in absolute coordinates, that is, those of the crew station coordinate system. Before storing on the Data Base, the coordinates are translated and rotated to the COMBIMAN system of coordinates by CBMCM.

If the control is located on a defined panel, its coordinates can be given relative to any vertex of the panel. In this instance, the x- and y-displacements are given relative to the vertex number specified. The z-value must be zero.

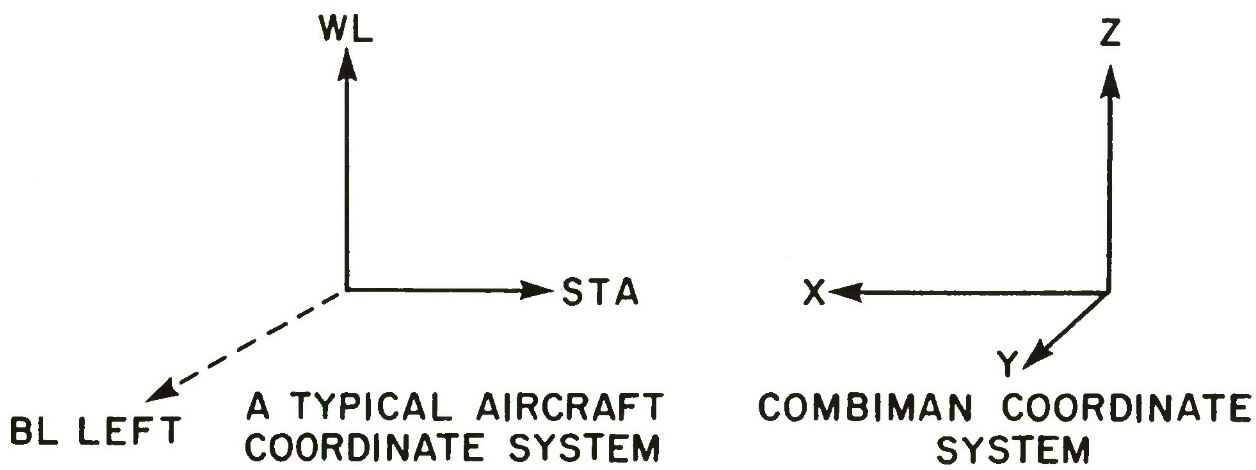


Figure 102. An Example of a Typical Aircraft Coordinate System and Its Related COMBIMAN Coordinate System.

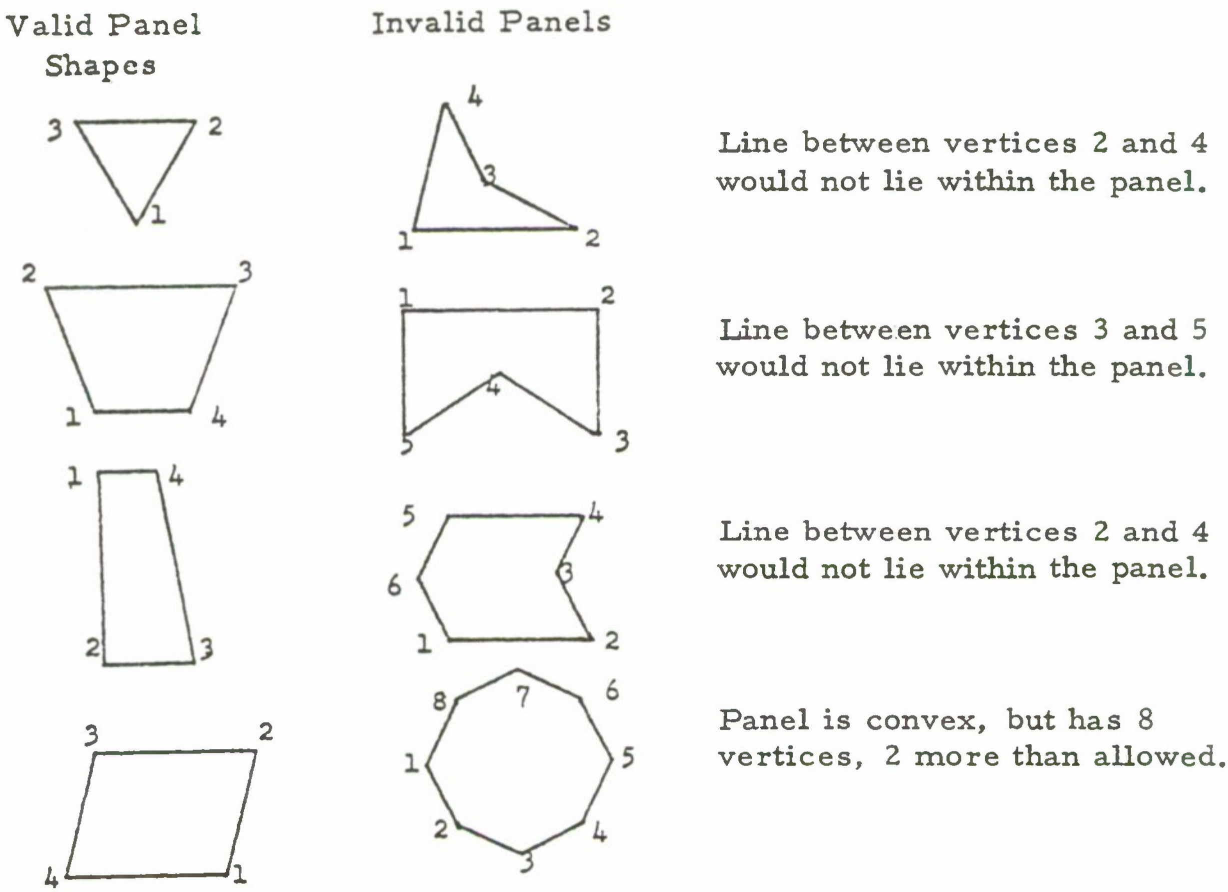
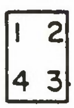


Figure 103. Example of Valid and Invalid Panels.

1TOP

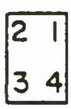
POINT	X	Y	Z
1	0.0	30.0	0.0
2	33.0	30.0	0.0
3	33.0	-30.0	0.0
4	0.0	-30.0	0.0

2DRWRS-LT



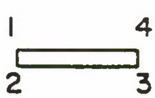
POINT	X	Y	Z
1	0.0	30.0	0.0
2	0.0	13.0	0.0
3	0.0	13.0	-21.0
4	0.0	30.0	-21.0

3DRWRS-RT



POINT	X	Y	Z
1	0.0	-30.0	0.0
2	0.0	-13.0	0.0
3	0.0	-13.0	-21.0
4	0.0	-30.0	-21.0

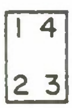
4DRWRS-CT



POINT	X	Y	Z
1	0.0	13.0	0.0
2	0.0	13.0	-5.0
3	0.0	-13.0	-5.0
4	0.0	-13.0	0.0

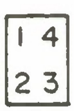
Figure 104. X, Y and Z Coordinates of Panels of DESK.

5 WELL - LT



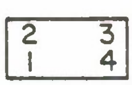
POINT	X	Y	Z
1	0.0	13.0	-5.0
2	0.0	13.0	-21.0
3	33.0	13.0	-21.0
4	33.0	13.0	-5.0

6 WELL - RT



POINT	X	Y	Z
1	0.0	-13.0	-5.0
2	0.0	-13.0	-21.0
3	33.0	-13.0	-21.0
4	33.0	-13.0	-5.0

7 WELL - TOP



POINT	X	Y	Z
1	0.0	13.0	-5.0
2	33.0	13.0	-5.0
3	33.0	-13.0	-5.0
4	0.0	-13.0	-5.0

Figure 105. X, Y and Z Coordinates of Panels of DESK.

The x-displacement is the offset from the vertex number n in the direction of the line connecting the nth and (n-1)th vertices. The y-displacement is in direction of the line connecting nth and (n+1)th vertices. The convention for determining the location of a control in a panel relative to its vertices is shown in Figure 106.

5.3.2 Processing Specifications

Program CBMCM allows the user to maintain the Data Base by adding, deleting, listing, etc. the crew station definitions. The formats to request the functions are shown in Figure 107. These requests (one request per card) plus the crew station definitions are used as input to the program. The control cards may be input in any order with one exception: when the Data Base is initialized or reinitialized, the $INT control card must be the first input data card. The control card formats are described in the following paragraphs.

5.3.2.1 ADD CREW STATION MEMBER Function

$ADD <u>membername</u> <u>npnls</u> <u>nctls</u> <u>srpx</u>

<u>srpy</u> <u>srpz</u> <u>x</u> <u>y</u> <u>z</u> (followed by a crew station definition).

The ADD CREW STATION MEMBER function adds the specified data under the name <u>membername</u> to the Crew Station Data Base. The membername is limited to a length of eight characters. The crew station definition contains <u>npnls</u> panels, and <u>nctls</u> controls. These numbers should be entered as integers, right justified in their three digit fields. The Seat Reference Point (SRP) coordinates are <u>srpx</u>, <u>srpy</u>, and <u>srpz</u> and are entered in F6.2 Format. If a decimal point is omitted, the program CBMCM will assume a decimal point between the second and third digits from the right. The directions of the positive <u>x</u>, <u>y</u>, and <u>z</u> coordinate axes are indicated by the characters in the <u>x</u>, <u>y</u>, and <u>z</u> fields respectively. The possible values for x, y, and z are F for Forward, A for Aft, L for

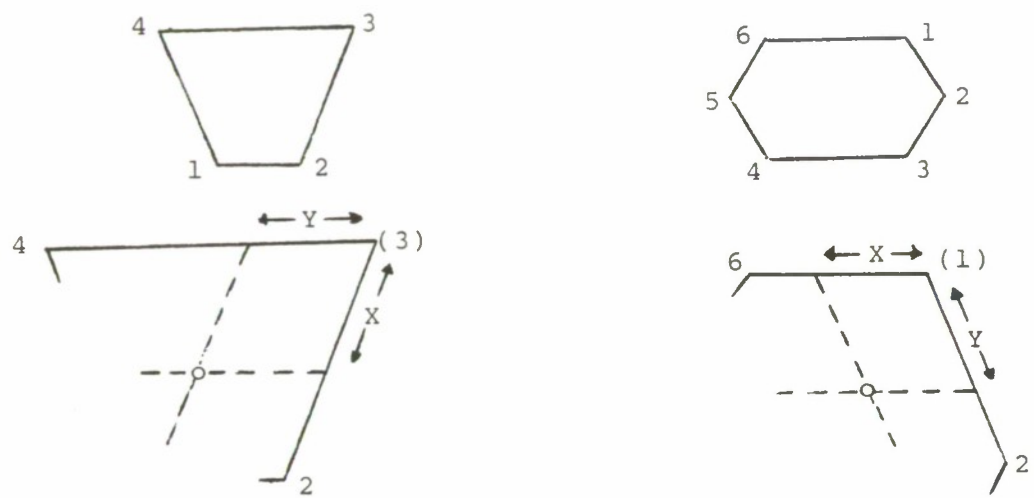


Figure 106. Convention for Determining the Location of a Control in a Panel Relative to its Vertices.

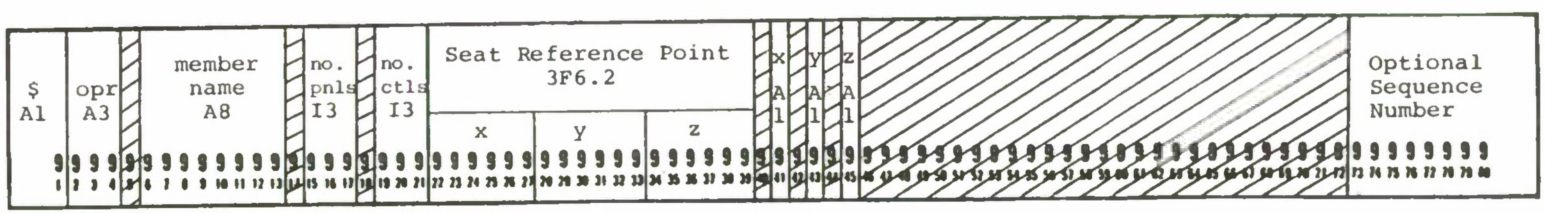


Figure 107. Program CBMCM Control Card Format.

Left, R for Right, U for Up, and D for Down. These directions are given with respect to the seated crewmember. If the crew station represents a seat, the last four letters of its member-name should be "SEAT".

For each crew station panel there are two format data cards, shown in Figures 108 and 109. In Figure 108, columns 1-3 contain an integer sequence number of the panel, right justified in the field. The first panel entered should have the sequence number "1". Panel numbers need not be consecutive, but they must be unique. Columns 4-11 contain the eight-character name of the panel. Columns 15-17 contain the panel type, as an integer, right justified. The panel types are "0" or "1" for general crew station panel, "2" for seat panel, and "3" for a rudder/brake pedal panel. If no type code is specified, "1" is assumed. Column 18 contains the number of vertices of the panel; the panel <u>must</u> have 3 to 6 vertices. The x, y and z coordinates of each vertex are entered consecutively, going either clockwise or counterclockwise around the perimeter of the panel.

Each control is defined on a card using the format in Figure 110. The <u>control name</u> is listed in columns 1-8. If the control is defined relative to a vertex, <u>pnl#</u> references a previously defined panel and is entered as an integer value, right justified in the field. The vertex to which the control is defined relative to is specified in the one-digit field <u>v#</u>. If a non-zero value is entered for <u>pnl#</u>, a non-zero value must be entered for the field <u>v#</u>. If the location is relative to a defined panel, the z-field is left blank. If the location of the control is absolute, x, y, and z values must be supplied. The coordinates of the control are assumed to be real numbers. If no decimal point is supplied, the program assumes a decimal point between the second and third digits from the right.

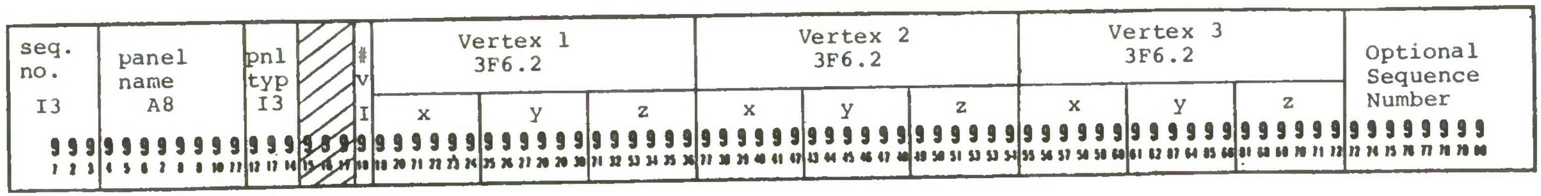


Figure 108. Program CBMCM ADD Member Card Format for Panels.

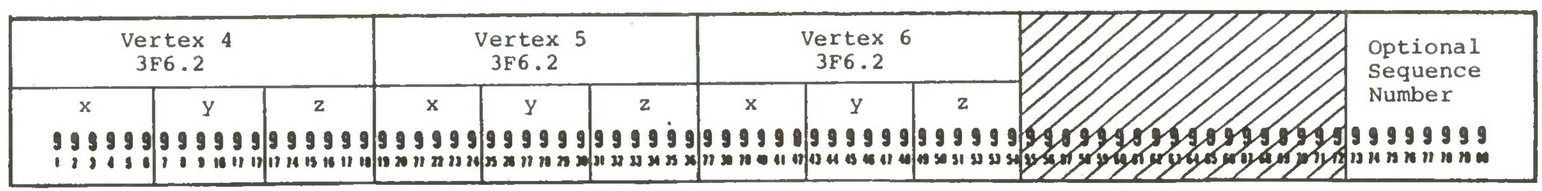


Figure 109. Program CBMCM ADD Member Card Format for Panels (Continued).

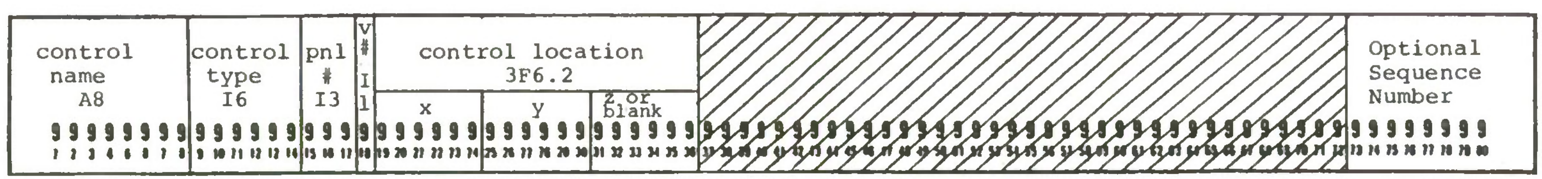


Figure 110. Program CBMCM ADD Member Card Format for Controls.

An example of the input definition for the member "DESK" is shown in Figure 111. The first outlined area is the $ADD control card. The second outlined area shows the panel definition cards followed by the control definition cards in outlined area (3).

If the program detects an error in the input data for a member, the member will not be added to the Data Base.

5.3.2.2 CHECK CREW STATION MEMBER Function

$CHK <u>membername</u> <u>npnls</u> <u>nctls</u> <u>srpx</u> <u>srpy</u> <u>srpz</u> <u>x</u> <u>y</u> <u>z</u> (followed by a crew station definition).

The CHECK CREW STATION MEMBER function operates in the same way the ADD CREW STATION MEMBER function does, <u>EXCEPT</u> that the member is not added. This function checks new member input data for proper format and content.

5.3.2.3 DELETE CREW STATION MEMBER Function

$DEL <u>membername</u>

The DELETE CREW STATION MEMBER function removes the specified crew station member from the Data Base, but does <u>NOT</u> make the space occupied by the member available for reuse. In order to make the space available to add more crew stations, the COMPRESS CREW STATION DATA BASE function must be used.

```
$ADD DESK           7    8 -15.0    0.0 -11.0 F L U                                      (1)
   1TOP            04    0.0  30.0    0.0  33.0  30.0    0.0  33.0 -30.0    0.0
    0.0 -30.0     0.0
   2DRWRS-LT       04    0.0  30.0    0.0   0.0  13.0    0.0   0.0  13.0  -21.0
    0.0  30.0   -21.0
   3DRWRS-RT       04    0.0 -30.0    0.0   0.0 -13.0    0.0   0.0 -13.0  -21.0
    0.0 -30.0   -21.0
   4DRWRS-CT       04    0.0  13.0    0.0   0.0  13.0   -5.0   0.0 -13.0   -5.0         (2)
    0.0 -13.0     0.0
   5WELL-LT        04    0.0  13.0   -5.0   0.0  13.0  -21.0  33.0  13.0  -21.0
   33.0  13.0    -5.0
   6WELL-RT        04    0.0 -13.0   -5.0   0.0 -13.0  -21.0  33.0 -13.0  -21.0
   33.0 -13.0    -5.0
   7WELL-TOP       04    0.0  13.0   -5.0  33.0  13.0   -5.0  33.0 -13.0   -5.0
    0.0 -13.0    -5.0
 L-F-CRNR       0  12    0.0   0.0
 L-S-CRNR       0  11    0.0   0.0
 R-F-CRNR       0  13    0.0   0.0
 R-S-CRNR       0  14    0.0   0.0                                                     (3)
 ORWRCTNR       0  42    0.0 -13.0
 ORWRLB         0  00   -1.0  22.0  -19.0
 ORWRLC         0  00   -1.0  22.0  -13.0
 ORWRLT         0  00   -1.0  22.0   -7.0
```

Figure 111. Sample Data for $ADD Member Function.

5.3.2.4 COMPRESS CREW STATION DATA BASE Function

$CMP

The COMPRESS CREW STATION DATA BASE function compresses used space together maximizing the amount of continuous unused space. The intermediate blocks of unused space are created by the DELETE CREW STATION MEMBER function. When the message "CBM127A NO SPACE, CANNOT ADD membername" appears while adding a crew station it is necessary to use this function. If the $ADD function gives the CBM127A message immediately after the $CMP function, the Data Base is full.

5.3.2.5 DUMP CREW STATION MEMBER Function

$DMP membername
$DMP

The DUMP CREW STATION MEMBER function prints the contents of the crew station member membername, or prints the complete Crew Station Data Base if member name is omitted on the control card. The format of the display is:

```
RECORD nn +=+ (record in EBCDIC)              +=+
+=+ (record in hexadecimal)                   +=+
+=+ (rest of record in hexadecimal)           +=+
```

The +=+ characters act as delimeters of the displayed data. This function is used primarily by system programmers to test the file.

5.3.2.6 END PROGRAM Function

$END

The END PROGRAM function terminates execution of the program CBMCM.

5.3.2.7 INITIALIZE CREW STATION DATA BASE Function

$INT

The INITIALIZE CREW STATION DATA BASE function resets the Data Base to the original unused state. The primary purpose of this function is to establish a Crew Station Data Base.

5.3.2.8 PUNCH CREW STATION MEMBER Function

$PCH <u>membername</u>

The PUNCH CREW STATION MEMBER function punches a copy of the specified member in a format that the ADD CREW STATION MEMBER function requires. Specifying a membername that does not exist on the directory will result in a printout of all the membernames on the Data Base.

5.3.2.9 PRINT CREW STATION MEMBER Function

$PRT <u>membername</u>
$PRT

The PRINT CREW STATION MEMBER function prints the contents of the specified member, <u>membername</u>, in a format similar to that of the ADD CREW STATION MEMBER function. Specifying no name, or a nonexisting name causes a printout of the index containing membernames, their record locations on the Data Base, and the origin and orientation of their coordinate systems.

5.3.3 <u>Submitting a Processing Request</u>

The sequence of JOB CONTROL LANGUAGE (JCL) cards needed to execute the program CBMCM are shown in Figure 112. All function control cards and member definition cards follow

```
//CBMCM    JOB HESS                                                     00001000
//JOBLIB   DD DSN=COMBIMAN.LOADLIB,DISP=SHR                             00001100
//CBMCM    EXEC PGM=CBMCM                                               00001200
//FT01F001 DD DSN=COMBIMAN.CRSTDATA,DISP=SHR                            00001300
//FT05F001 DD DDNAME=SYSIN                                              00001400
//FT06F001 DD SYSOUT=A                                                  00001500
//FT07F001 DD SYSOUT=B                                                  00001600
//SYSUDUMP DD SYSOUT=A                                                  00001700
//SYSIN    DD *                                                         00001800


           CBMCM FUNCTION CONTROL CARDS AND
              MEMBER DEFINITION DATA


/*
//                                                                      00001900
```

Figure 112. Job Control Cards to Execute Program CBMCM.

```
//FT01F001 DD DSN=COMBIMAN.CRSTDATA,UNIT=DISK,DISP=(NEW,CATLG),         00001300
//             VOL=SER=DISK01,SPACE=(368,2000),                         00001310
//             DCB=(BLKSIZE=368,LRECL=368,RECFM=FB)                     00001320
```

Figure 113. FT01 DD Card to Allocate Space on Disk and Execute Program CBMCM.

the "//SYSIN DD*" card. The "//FT01F001" DD card included in this sequence assumes that the space for the Data Base has already been allocated on disk. If the Data Base does not exist, the "//FT01F001" DD card specified in Figure 112 should be replaced by the sequence of cards shown in Figure 113. This sequence to allocate space for the Data Base and to initialize it should be executed only once. Thereafter, the simplified "//FT01F001" DD card shown in Figure 112 should be used for all file manipulations.

Once the Data Base is allocated on Disk, it must be initialized using $INT function before using any other function. For every CBMCM job, the last function control card read into the program should be the "$END" card.

5.3.4 Output Data Interpretation

The program CBMCM generates output to the card punch, disk file, or printer, depending on the specified control card function. The formats for the printed output will be discussed in this section. Punched records have the same format as the input data records discussed in Paragraph 5.3.2. The physical format of the records on the Data Base is not described here.

Five basic formats are used by CBMCM for printed output. These format types, their use, and their examples are presented in this subsection. All types begin with the same heading "CBMCM", the date and time of the program execution, and page number.

The first type of output is generated by the INITIALIZE, PUNCH, COMPRESS, DELETE, and END functions. The output indicates the start and end of processing associated with the specified function. For the COMPRESS function additional

messages indicating that a particular member is, or is not moved in the process of combining unused space is also printed. An example of this format, for the COMPRESS function, is shown in Figure 114.

The second type of output is generated by the PRINT or PUNCH functions when the $PRT or $PCH control card is supplied with blank membername field. This causes the index of the Data Base printed in the following format:

nn.) membername, EXTENT=(n1,n2), np PANELS, nc CONTROLS,
ORIGIN=(xx, yy, zz), ORIENT=(a, b, c)

where:

nn	is the number of the member identification record within the directory
membername	is the name of the member identified
n1	is the location of the first record which defines this member
n2	is the location of the last record which defines this member
np	is the number of panels associated with this member
nc	is the number of controls associated with this member
xx yy zz	is the location of the seat reference point with respect to the origin of the coordinate system of the crew station
a	is the orientation of the positive x-axis of the crew station
b	is the orientation of the positive y-axis of the crew station
c	is the orientation of the positive z-axis of the crew station

An example of the PRINT function is shown in Figure 115.

```
CBM100I $CMP
CBM128I HAC1      WAS IN PLACE.
CBM128I A7E       WAS IN PLACE.
CBM128I A7        WAS IN PLACE.
CBM128I FWC1      WAS IN PLACE.
CBM128I A7-01     WAS IN PLACE.
CBM128I A7E-01    WAS IN PLACE.
CBM129I B1-CHAIR  NOW IN PLACE.
CBM129I B1-NAV01  NOW IN PLACE.
CBM129I B1-NAV1A  NOW IN PLACE.
CBM129I B1-NAV2A  NOW IN PLACE.
CBM129I SACR      NOW IN PLACE.
CBM129I SACL      NOW IN PLACE.
CBM129I DESK      NOW IN PLACE.
CBM138I COMPRESS FINISHED.
```

Figure 114. A Sample Output of the $CMP Function.

```
CBM100I $PRT
      9.) SACR    , EXTENT=(   782,    805),  23 PANELS,   1 CONTROLS, ORIGIN=( -27.00,  59.25, -15.75), ORIENT.=(F,R,U).
     10.) SACL    , EXTENT=(   806,    829),  23 PANELS,   1 CONTROLS, ORIGIN=( -27.00,  19.25, -15.75), ORIENT.=(F,R,U).
     11.) B1-NAV2A, EXTENT=(   754,    781),  27 PANELS,   1 CONTROLS, ORIGIN=(  22.00, 396.61,  62.50), ORIENT.=(R,A,U).
     12.) B1-CHAIR, EXTENT=(   689,    693),   4 PANELS,   1 CONTROLS, ORIGIN=(   0.0 ,   0.0 ,   0.0 ), ORIENT.=(A,R,U).
     13.) B1-NAV1A, EXTENT=(   724,    753),  29 PANELS,   1 CONTROLS, ORIGIN=(  22.00, 396.61,  62.50), ORIENT.=(R,A,U).
     14.) B1-NAV01, EXTENT=(   694,    723),  29 PANELS,   1 CONTROLS, ORIGIN=(  22.00, 396.61,  62.50), ORIENT.=(R,A,U).
     15.) A7E-01  , EXTENT=(   592,    688),  51 PANELS,  46 CONTROLS, ORIGIN=(   0.0 ,   0.0 ,   0.0 ), ORIENT.=(F,L,U).
     16.) A7-01   , EXTENT=(   489,    591),  57 PANELS,  46 CONTROLS, ORIGIN=(   0.0 ,  -5.60,  -4.25), ORIENT.=(R,F,U).
     17.) A7      , EXTENT=(   358,    460),  57 PANELS,  46 CONTROLS, ORIGIN=(   0.0 ,   0.0 ,   0.0 ), ORIENT.=(R,F,U).
     18.) FWC1    , EXTENT=(   461,    488),  27 PANELS,   1 CONTROLS, ORIGIN=(   5.00,   0.0 ,   3.00), ORIENT.=(F,L,U).
     19.) A7E     , EXTENT=(    45,    357), 204 PANELS, 109 CONTROLS, ORIGIN=(   0.0 , 103.40, 265.00), ORIENT.=(R,U,A).
     20.) HAC1    , EXTENT=(    22,     44),  18 PANELS,   5 CONTROLS, ORIGIN=(  16.00,   0.0 ,  18.00), ORIENT.=(F,L,U).
     21.) DESK    , EXTENT=(   830,    844),   7 PANELS,   8 CONTROLS, ORIGIN=( -15.00,   0.0 , -11.00), ORIENT.=(F,L,U).
```

Figure 115. A Sample Output of the $PRT (No Membername) Function.

The third type of output is generated by the DUMP function. This function is intended to be used primarily by system programmers to locate the cause of I/O (Input/Output) errors on the Data Base. For the member specified on the $DMP control card, a message giving directory or index information is printed using the second output format described elsewhere. Each data record associated with the member is printed in the following format:

```
RECORD nn +=+ (record in EBCDIC)                   +=+
+=+ (record in hexadecimal)                        +=+
+=+ (remainder of record in hexadecimal)           +=+
```

where nn is the location of the record within the Data Base. The record in EBCDIC is printed using a 25A4 format. The record in hexadecimal is printed using a 10Z8 format. An example of the output for the DUMP function is shown in Figure 116.

The fourth output format is used by the CHECK and ADD functions. After reading the control card and checking it for errors, the information contained on the card is reformatted and written out to the printer. If any error is detected, the error messages pertaining to data contained on the card are printed first.

The panel definition cards, after being read and checked for errors, are printed in the following format:

nn.) pnl nm, TYPE=tt, nv VERTICES--INPUT COORD-- --ABSOLUTE COORD --

(xx_1, yy_1, zz_1) (ax_1, ay_1, ax_1)

.
.
.

$(xx_{nv}, yy_{nv}, zz_{nv})$ $(ax_{nv}, ay_{nv}, az_{nv})$

```
CBM1001 $DMP DESK
     21.) DESK     , EXTENT=(      830,      844),     7 PANELS,    8 CONTROLS, ORIGIN=( -15.00,    0.0 , -11.00), ORIENT.=(F,L,U).
     RECORD  830+=+     TOP                 0                                        B         0  B                                       +=+
     +=+00000001E3D6D740404040400C00000000000000441F00000421E000041B0000C4230000421E000041B00000423000000+=+
     +=+C21E000041B000041F00000C21E000041B000000000000000000000000000000000000000000000000000000+=+
     RECORD  831+=+    DRWRS-LT             0                0                0      A      0       A                                    +=+
     +=+00000002C4D9E609E260D3E3000000000000000000441F00000421E000041B00000041F0000041D000004180000041F00000+=+
     +=+41000000C1A0000041F0000421E0000C1A000C00000000000000000000000000000000000000000000000000+=+
     RECORD  832+=+    DRWRS-RT             0  B             0  A             0  A    A      0   B    A                                  +=+
     +=+00000003C4D9E6D9E26009E300000000000000000441F00000C21E000041B0000041F00000C1D000004180000041F00000+=+
     +=+C1D00000C1A000041F00000C21E0000C1A000C000000000000000000000000000000000000000000000000+=+
     RECORD  833+=+    DRWRS-CT             0                0          -     0  A       -     0  A                                      +=+
     +=+00000004C4D9E609E260C3E300000000000000000441F00000041D00000418000041F0000041D000004160000041F00000+=+
     +=+C1D0000041600000041F00000C1D000041B00000000000000000000000000000000000000000000000000000+=+
     RECORD  834+=+     WELL-LT             0           -    0          A                   A                  -                         +=+
     +=+00000005E6C5D3D360D3E3400000000000000000441F00000041D00000416000041F0000041000000C1A000004230000+=+
     +=+41D00000C1A00000423000041D00000416000000000000000000000000000000000000000000000000000+=+
     RECORD  835+=+     WELL-RT             0  A      -     0   A     A             A      A          A        -                         +=+
     +=+00000006E6C503D360D9E3400000000000000000441F00000C1D00000416000041F00000C1000000C1A000004230000+=+
     +=+C1D00000C1A0000423000000C1D0000041600000000000000000000000000000000000000000000000000+=+
     RECORD  836+=+     WELL-TOP            0      -                  -             A       -      0  A       -                         +=+
     +=+00000007E6C50303 60E306D700000000000000000441F00000041D00000416000004230000041D00000416000004230000+=+
     +=+C1D0000041600000041F00000C1D00000041 60C0C00000000000000000000000000000000000000000000+=+
     RECORD  837+=+L-F-CRNR                                                                                                              +=+
     +=+0360C660C309D509000000000000000010000000242300000421E000041B00000000000000000000000000000000000000+=+
     +=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
     RECORD  838+=+L-S-CRNR                 0                                                                                            +=+
     +=+D360E260C309D5D900000000000000001000000141F00000421E000041B0000C0000000000000000000000000000000000C+=+
     +=+0000000000000000000000000000000000000000000C000000000000000000000000000000000000000000+=+
     RECORD  839+=+R-F-CRNR                    B                                                                                         +=+
     +=+D960C660C3D90509000000000000000010000000342300000C21E000041B00000000000000000000000000000000000000+=+
     +=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
     RECORD  840+=+R-S-CRNR                 0   B                                                                                        +=+
     +=+D960E260C3D9D509000000000000000010000000441F00000C21E000041B0000000000000000000000000000000000000000+=+
     +=+00000000000000000000000000000000000000000C000C00000000000000000000000000000000000000000+=+
     RECORD  841+=+ORWRCTNR                 0            -            A                                                                  +=+
     +=+C4D9E6D9C3E3D5D9000000000000000400000000241F0000C0000000041600000000000000C1D000000000000000000000+=+
     +=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
     RECORD  842+=+ORWRLB                      A                                                                                        +=+
     +=+C4D9E6D903C2404000000000000000000000000000041E0000042160000C1800000000000000000000000000000000000+=+
     +=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
     RECORD  843+=+DRWRLC                      A                                                                                        +=+
     +=+C4D9E6D9D3C3404000000000000000000000000000041E0000042160000C1200000000000000000000000000000000000+=+
     +=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
     RECORD  844+=+ORWRLT                                                                                                               +=+
     +=+C4D9E60903E340400000000000C0000000000000041E000004216000041400000000000000000000000000000000000000+=+
     +=+0000000000000000000000000000000000000000000000000000000000000000000000000000000000000+=+
```

Figure 116. A Sample Output of the $DMP Function.

where:

nn	is the panel number
pnl nm	is the panel name
tt	is the panel type
nv	is the number of vertices used to define the panel
xx_i, yy_i, zz_i	are the x, y, and z coordinates for the ith vertex of the panel, in the crew station system of coordinates, where i=1, nv.
ax_i, ay_i, ax_i	are the x, y, and z coordinates of the ith vertex of the panel, converted to the COMBIMAN system of coordinates, where i=1, nv.

After all the panel definition data are printed, CBMCM prints the control data using the following format:

cntl nm tt pnl ref. v.# (xx,yy,zz) TO (ax,ay,az) & (rx,ry)

where:

cntl nm	is the 8 character name of the control
tt	is the 2 digit control type
pnl ref	is the panel where the control is located (if applicable)
v.#	is the reference vertex number for that control (if applicable)
xx yy zz	are the three dimensional coordinates (relative or absolute) which define the location of the control
ax ay az	are the absolute three dimensional coordinates which define the location of the control in the COMBIMAN system of coordinates
rx ry	are the two dimensional relative coordinates of the control. If the control is not defined relative to a panel, rx=ry=0.0.

An example of this fourth output format for the $ADD function is shown in Figure 117.

The fifth and last format is similar to that used for the ADD function input, and is used for the PRINT function when a valid membername is specified. The main difference between this format and the fourth is that this format does not print the original input data used to add the member to the Data Base. After printing the index record for the member, the program CBMCM prints the panel definition data in the following format:

<u>nn</u>.) <u>pnl nm</u>, TYPE=<u>tt</u>, <u>nv</u> VERTICES--ABSOLUTE COORDINATES--

(xx_1, yy_1, zz_1)
.
.
.
$(xx_{nv}, yy_{nv}, zz_{nv})$

where:

<u>nn</u>	is the panel number
<u>pnl nm</u>	is the 8-character name of the panel
<u>tt</u>	is the panel type
<u>nv</u>	is the number of vertices which define the panel
xx_i, yy_i, zz_i	are the x, y, and z coordinates of the ith vertex of the panel, in the COMBIMAN system of coordinates, where i=1, nv.

After printing the panel definiton data, the program prints the control data using the following format:

<u>cntl nm</u> <u>tt</u> <u>pnl ref</u> <u>v#</u> (<u>ax</u>, <u>ay</u>, <u>az</u>) (<u>rx</u>, <u>ry</u>)

where:

<u>cntl nm</u>	is the 8 character name of the control
<u>tt</u>	is the 2 digit control type

```
CBM1001 $ADD DESK        7   8-15.00  0.0 -11.00 F L O
CBM1191 MEMBER, DESK     , HAS   7 PANELS AND   8 CONTROLS.
CBM1201 COORDINATES ARE TRANSLATED TO ( -15.00,    0.0 , -11.00).
CBM1211 COORDINATES GIVEN AS F, L AND O ARE NOW F, L, AND O.
        1.) TOP      , TYPE= 0, 4 VERTICES --INPUT COORDINATES---     --ABSOLUTE COORDINATES-
                                  (  0.0    30.00    0.0 ) TO (  15.00  30.00  11.00)
                                  ( 33.00   30.00    0.0 ) TO (  48.00  30.00  11.00)
                                  ( 33.00  -30.00    0.0 ) TO (  48.00 -30.00  11.00)
                                  (  0.0   -30.00    0.0 ) TO (  15.00 -30.00  11.00)
        2.) ORWRS-LT, TYPE= 0, 4 VERTICES --INPUT COORDINATES---     --ABSOLUTE COORDINATES-
                                  (  0.0    30.00    0.0 ) TO (  15.00  30.00  11.00)
                                  (  0.0    13.00    0.0 ) TO (  15.00  13.00  11.00)
                                  (  0.0    13.00  -21.00) TO (  15.00  13.00 -10.00)
                                  (  0.0    30.00  -21.00) TO (  15.00  30.00 -10.00)
        3.) ORWRS-RT, TYPE= 0, 4 VERTICES --INPUT COORDINATES---     --ABSOLUTE COORDINATES-
                                  (  0.0   -30.00    0.0 ) TO (  15.00 -30.00  11.00)
                                  (  0.0   -13.00    0.0 ) TO (  15.00 -13.00  11.00)
                                  (  0.0   -13.00  -21.00) TO (  15.00 -13.00 -10.00)
                                  (  0.0   -30.00  -21.00) TO (  15.00 -30.00 -10.00)
        4.) ORWRS-CT, TYPE= 0, 4 VERTICES --INPUT COORDINATES---     --ABSOLUTE COORDINATES-
                                  (  0.0    13.00    0.0 ) TO (  15.00  13.00  11.00)
                                  (  0.0    13.00   -5.00) TO (  15.00  13.00   6.00)
                                  (  0.0   -13.00   -5.00) TO (  15.00 -13.00   6.00)
                                  (  0.0   -13.00    0.0 ) TO (  15.00 -13.00  11.00)
        5.) WELL-LT , TYPE= 0, 4 VERTICES --INPUT COORDINATES---     --ABSOLUTE COORDINATES-
                                  (  0.0    13.00   -5.00) TO (  15.00  13.00   6.00)
                                  (  0.0    13.00  -21.00) TO (  15.00  13.00 -10.00)
                                  ( 33.00   13.00  -21.00) TO (  48.00  13.00 -10.00)
                                  ( 33.00   13.00   -5.00) TO (  48.00  13.00   6.00)
        6.) WELL-RT , TYPE= 0, 4 VERTICES --INPUT COORDINATES---     --ABSOLUTE COORDINATES-
                                  (  0.0   -13.00   -5.00) TO (  15.00 -13.00   6.00)
                                  (  0.0   -13.00  -21.00) TO (  15.00 -13.00 -10.00)
                                  ( 33.00  -13.00  -21.00) TO (  48.00 -13.00 -10.00)
                                  ( 33.00  -13.00   -5.00) TO (  48.00 -13.00   6.00)
        7.) WELL-TOP, TYPE= 0, 4 VERTICES --INPUT COORDINATES---     --ABSOLUTE COORDINATES-
                                  (  0.0    13.00   -5.00) TO (  15.00  13.00   6.00)
                                  ( 33.00   13.00   -5.00) TO (  48.00  13.00   6.00)
                                  ( 33.00  -13.00   -5.00) TO (  48.00 -13.00   6.00)
                                  (  0.0   -13.00   -5.00) TO (  15.00 -13.00   6.00)
     CONTROL- TYPE IN PANEL POINT ---INPUT COORDINATES---     --ABSOLUTE COORDINATES-  RELATIVE-COORDINATES
     -------- ---- -------- ----- ---------------------     ---------------------    ------------------
     L-F-CRNR   0  TOP         2  (  0.0    0.0    0.0 ) TO (  48.00  30.00  11.00) & (  0.0    0.0 )
     L-S-CRNR   0  TOP         1  (  0.0    0.0    0.0 ) TO (  15.00  30.00  11.00) & (  0.0    0.0 )
     R-F-CRNR   0  TOP         3  (  0.0    0.0    0.0 ) TO (  48.00 -30.00  11.00) & (  0.0    0.0 )
     R-S-CRNR   0  TOP         4  (  0.0    0.0    0.0 ) TO (  15.00 -30.00  11.00) & (  0.0    0.0 )
     ORWRCTNR   0  ORWRS-CT    2  (  0.0  -13.00   0.0 ) TO (  15.00   0.0    6.00) & (  0.0  -13.00)
     ORWRLB     0              0  ( -1.00  22.00 -19.00) TO (  14.00  22.00  -8.00) & (  0.0    0.0 )
     ORWRLC     0              0  ( -1.00  22.00 -13.00) TO (  14.00  22.00  -2.00) & (  0.0    0.0 )
     ORWRLT     0              0  ( -1.00  22.00  -7.00) TO (  14.00  22.00   4.00) & (  0.0    0.0 )
CBM1341 DESK     WITH    7 PANELS AND    8 CONTROLS HAS BEEN ADDED.
```

Figure 117. Example of Program CBMCM $ADD (Membername) Function Output Format.

pnl ref — is the panel on which the control is located (if applicable)

v# — is the reference vertex number of the panel for that control (if applicable)

ax, ay, az — are the three dimensional coordinates which define the control in the COMBIMAN system of coordinates

rx, ry — are the two dimensional relative coordinates of the control. If the control was not defined relative to a panel, rx=ry=0.0.

An example of the output for the $PRT function using the fifth format is shown in Figure 118.

5.4 PROGRAM MESSAGES - INCLUDING ERROR CORRECTION

The program CBMCM prints both information and action related messages. The message format is as follows:

CBMlnni   message text

where

nn — is the message number

i — indicates the action code (I=informational, A=action to be performed), and

message text — is the text of the message.

Unless otherwise noted, all messages are generated by the routine CBMCM.

The messages are as follows:

CBM100I   control card image

Reason:	User submitted a control card.
System Action:	Continues processing.
User Action:	None.

```
CBMJ001 $PRT DESK
       21.) DESK     , EXTENT=(     830,      844),    7 PANELS,    8 CONTROLS, ORIGIN=( -15.00,    0.0 , -11.00), ORIENT.=(F,L,U).
        1.) TOP      , TYPE= 0, 4 VERTICES --ABSOLUTE COORDINATES-
                                            (  15.00  30.00  11.00)
                                            (  48.00  30.00  11.00)
                                            (  48.00 -30.00  11.00)
                                            (  15.00 -30.00  11.00)
        2.) DRWRS-LT, TYPE= 0, 4 VERTICES --ABSOLUTE COORDINATES-
                                            (  15.00  30.00  11.00)
                                            (  15.00  13.00  11.00)
                                            (  15.00  13.00 -10.00)
                                            (  15.00  30.00 -10.00)
        3.) DRWRS-RT, TYPE= 0, 4 VERTICES --ABSOLUTE COORDINATES-
                                            (  15.00 -30.00  11.00)
                                            (  15.00 -13.00  11.00)
                                            (  15.00 -13.00 -10.00)
                                            (  15.00 -30.00 -10.00)
        4.) DRWRS-CT, TYPE= 0, 4 VERTICES --ABSOLUTE COORDINATES-
                                            (  15.00  13.00  11.00)
                                            (  15.00  13.00   6.00)
                                            (  15.00 -13.00   6.00)
                                            (  15.00 -13.00  11.00)
        5.) WELL-LT , TYPE= 0, 4 VERTICES --ABSOLUTE COORDINATES-
                                            (  15.00  13.00   6.00)
                                            (  15.00  13.00 -10.00)
                                            (  48.00  13.00 -10.00)
                                            (  48.00  13.00   6.00)
        6.) WELL-RT , TYPE= 0, 4 VERTICES --ABSOLUTE COORDINATES-
                                            (  15.00 -13.00   6.00)
                                            (  15.00 -13.00 -10.00)
                                            (  48.00 -13.00 -10.00)
                                            (  48.00 -13.00   6.00)
        7.) WELL-TOP, TYPE= 0, 4 VERTICES --ABSOLUTE COORDINATES-
                                            (  15.00  13.00   6.00)
                                            (  48.00  13.00   6.00)
                                            (  48.00 -13.00   6.00)
                                            (  15.00 -13.00   6.00)
    CONTROL- TYPE IN-PANEL POINT --ABSOLUTE COORDINATES-  RELATIVE-COORDINATE
    -------- ---- -------- ----- ---------------------    -------------------
    L-F-CRNR    0 TOP         2   (  48.00  30.00  11.00)  (    0.0     0.0 )
    L-S-CRNR    0 TOP         1   (  15.00  30.00  11.00)  (    0.0     0.0 )
    R-F-CRNR    0 TOP         3   (  48.00 -30.00  11.00)  (    0.0     0.0 )
    R-S-CRNR    0 TOP         4   (  15.00 -30.00  11.00)  (    0.0     0.0 )
    DRWRCTNR    0 DRWRS-CT    2   (  15.00   0.0    6.00)  (    0.0   -13.00)
    DRWRLB      0             0   (  14.00  22.00  -8.00)  (    0.0     0.0 )
    DRWRLC      0             0   (  14.00  22.00  -2.00)  (    0.0     0.0 )
    DRWRLT      0             0   (  14.00  22.00   4.00)  (    0.0     0.0 )
```

Figure 118. A Sample Output the $PRT Function.

CBM101A operation UNKNOWN OPERATION.

Reason: The operation on the control card shown in the previous CBM100I message, is unknown.

System Action: Ignores this control card.

User Action: Correct the card and resubmit.

CBM102A panelnumber INVALID PANEL NUMBER FOR POINT controlname.

Reason: The panel number specified by the control definition card does not exist.

System Action: Assumes that the control is defined in absolute coordinates.

User Action: Delete the crew station member, correct the card, and resubmit.

CBM103A vertexnumber INVALID VERTEX NUMBER FOR POINT controlname.

Reason: The panel in which the control is defined does not have vertex vertexnumber.

System Action: Uses vertex number 1.

User Action: Delete the crew station member, correct the error, and resubmit.

CBM104A Z NOT ZERO, PANEL & VERTEX NOW ZERO FOR POINT controlname.

Reason: A panel number and a vertex number are specified, but the Z value is not zero.

System Action: Makes Z zero and continues processing.

User Action: If setting Z equal to zero corrects the problem, no action needed. Otherwise, delete the crew station member, correct the data card and resubmit.

CBM105A NO NAME GIVEN, operation IGNORED

Reason: This operation requires a crew station member name, but no name is specified.

System Action: Ignores the operation.

User Action: Supply the member name and resubmit.

CBM106A membername NOT FOUND.

Reason: For the DELETE, DUMP, PUNCH or PRINT function, the specified crew station member name does not exist.

System Action: Prints the Crew Station Data Base directory.

User Action: Correct the error and resubmit.

CBM107A NUMBER OF PANELS/CONTROLS INVALID FOR MEMBER <u>membername</u>.

Reason: The number of panels or controls as specified on the ADD function control card ($ADD) is either less than 1 or greater than 300.

System Action: Ignores the control card.

User Action: If the number as specified is less than 1, correct and resubmit. If the number as specified is greater than 300, split the crew station definition into two units and add them separately.

CBM109A <u>axis</u> FOR Y INVALID, MEMBER IS <u>membername</u>.

Reason: During the ADD function ($ADD), the direction of the user's Y-axis is not F, A, L, R, U or D.

System Action: Ignores the control card.

User Action: Correct the control card and resubmit.

CBM110A <u>axis</u> FOR Z INVALID, MEMBER IS <u>membername</u>.

Reason: During the ADD function ($ADD), the direction of the user's Z-axis is not F, A, L, R, U or D.

System Action: Ignores the control card.

User Action: Correct the control card and resubmit.

CBM111A X&Y, X&Z OR Y&Z ARE COLINEAR FOR MEMBER <u>membername</u>.

Reason: The directions of two or more of the user's axes are the same (ex. X=L, Y=U & Z=U or X=L, Y=U & Z=L).

System Action: Ignores the control card.

User Action: Pick unique directions for the axes and resubmit.

CBM112A DIRECTORY IS FULL, CANNOT ADD <u>membername</u>.

Reason: No space is available in the Crew Station Data Base directory to add an entry for this member.

System Action: Ignores the control card.

User Action: Delete a member and resubmit.

CBM113A PANEL IS ZERO, BUT POINT IS NOT FOR <u>membername</u>.

Reason: In defining a control, either the panel number and the vertex number must be zero, or both numbers must be non-zero. Note that blank entry is converted to zero.

System Action: Takes the control definition as absolute.

User Action: Delete the crew station, correct the error and resubmit.

CBM114A membername ALREADY EXISTS.

Reason: User tried to add a crew station definiton under a name that already exists on the Data Base.

System Action: Ignores the control card.

User Action: Use a new name, and resubmit.

CBM115A END OF DATA.

Reason: The end of file was found before the END Program control card ($END).

System Action: Terminates the program.

User Action: Check to make sure that all the control cards are processed.

CBM116A I/O ERROR ON RECORD recordnumber (INDEX).

Reason: An I/O error occurred on the Crew Station Data Base.

System Action: Terminates the program.

User Action: Contact systems programmmer.

CBM117A I/O ERROR ON RECORD recordnumber (DATA).

Reason: An I/O error occurred on the Crew Station Data Base.

System Action: Terminates the program.

User Action: Contact systems programmer.

CBM119A NEW MEMBER, membername, HAS nn PANELS AND nn CONTROLS.

Reason: The user added a crew station definition to the Data Base.

System Action: The new crew station is added to the Data Base .

User Action: None.

CBM120I COORDINATES ARE TRANSLATED TO seat reference point coordinate.

Reason: The user added a crew station definition to the Data Base.

System Action: The addition is accepted.

User Action: None.

CBM121I COORDINATES GIVEN AS axis, axis AND axis ARE NOW R, F, AND U.

Reason: The user added a crew station definition to the Data Base.

System Action: The addition is accepted.

User Action: None.

CBM122I PROGRAM END.

Reason: The End Program function control card ($END) or the end of the file card is encountered, or there is an I/O error.

System Action: Terminates the program.

User Action: Check to make sure that all control cards are accepted, and processed correctly.

CBM123I membername DELETED.

Reason: The user submitted a delete Crew Station Definition function control card ($DEL).

System Action: Makes the requested deletion.

User Action: None.

CBM124I INITIALIZED.

Reason: The user requested that the Crew Station Data Base be initialized.

System Action: The Data Base is initialized.

User Action: None.

CBM125A PANEL NOT DEFINED FOR CONTROL controlname.

Reason: To define a control, the user specified the control in a panel not found in this crew station.

System Action: Assumes that the control is defined absolutely.

User Action: Make sure that the panel is defined. Correct and resubmit.

CBM126I membername PUNCHED.

Reason: The user requested that member membername be punched on cards.

System Action: Punches the data.

User Action: None.

CBM127A NO SPACE, CANNOT ADD membername.

Reason: There is not enough space in the data base to hold the requested addition.

System Action: Ignores the control card.

User Action: Compress the Data Base and resubmit.

CBM128I membername WAS IN PLACE.

Reason: The user requested that the Data Base be compressed. The member, membername, was already compressed and not moved.

System Action: The named member was not moved.

User Action: None.

CBM129I membername NOW IN PLACE.

Reason: The user requested that the Data Base be compressed. The member, membername was not in place, and therefore has been moved to facilitate compression.

System Action: The member is moved to another location in the Data Base.

User Action: None.

CBM130A panelname USED IN PANELS $panelnumber_1$ AND $panelnumber_2$.

Reason: In the crew station member definition, two panels have the same name. The number of these panels are $panelnumber_1$ and $panelnumber_2$.

System Action: Both panels are accepted in spite of the duplicate names.

User Action: Delete the definition, change one of the names, and resubmit.

CBM131A panelname HAS SAME PANEL NUMBER AS panelnumber.

Reason: In the crew station definition, two panels have the same panel number.

System Action: Both panels are acepted. Note that references to the second will cause a reference to the first.

User Action: Delete the crew station definition, correct the error, and resubmit.

CBM132A controlname IS A DUPLICATE NAME.

Reason: In adding a crew station definition, two controls have the same name.

System Action: Only the first control can be referenced.

User Action: Delete the definition, change one of the names to make it unique, and resubmit.

SECTION 6

COMBIMAN VISIBILITY DATA BASE MAINTENANCE PROGRAM (CBMVM)

One of the important functions provided by the interactive program CBM05 is the VISIBILITY PLOT function. This function evaluates the interaction of the visual man-model with a crew station. It uses the eye location of the current man-model and the three dimensional coordinates of selected crew stations, stored on the Visibility Data Base, to generate on-line plots of the man-model's field of vision. Note that the Visibility Data Base may contain the same geometric panels as the Crew Station Data Base, or alternately a subset of the Crew Station Data Base, or an entirely different set of panels and contours. A data flow of the program CBMVM is shown in Figure 119.

6.1 AVAILABLE PROCESSING

The program CBMVM allows the user to create and maintain the Visibility Data Base. Input data are supplied on 80-character computer cards or card images on magnetic tape or direct access device and are processed according to the user's selection of control commands. These commands allow the user to add or delete members, to print information about existing members, or to list contents of the Data Base. It can also be used to compress the members within the Data Base to maintain continuous blocks of available disk space.

The control cards may be input in any order with one exception: when the Data Base is created for the first time or is reinitialized, the $INT (initialize) control card must precede all other control cards and member definitions.

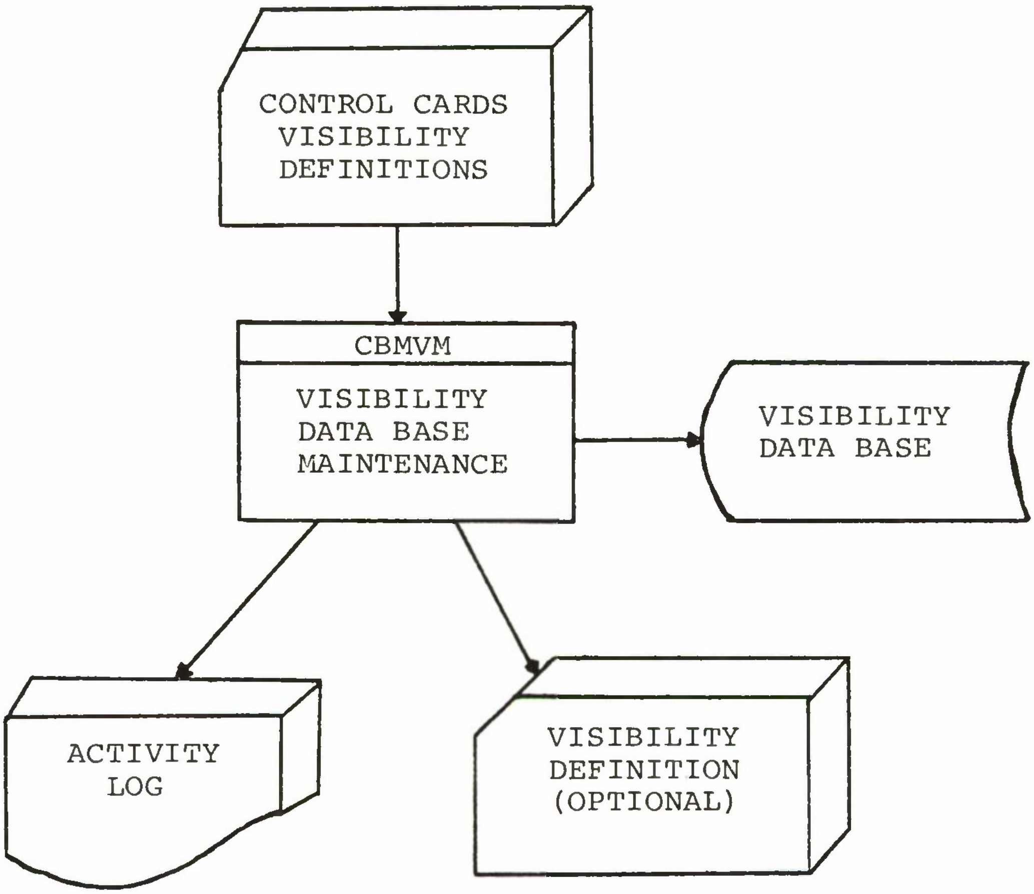


Figure 119. Data Flow for Program CBMVM.

6.2 RESTRICTIONS AND LIMITATIONS

A maximum of 20 crew station members may be added to the Visibility Data Base. Each member may contain up to 15 panels or contours. The panels and contours may consist of two to 100 vertices. The large number of vertices per panel allows a greater accuracy of approximating curved edges than is possible with the Crew Station Data Base. These vertices must be input in consecutive order, as described in Paragraph 6.3.1.

The total number of records available for coordinate information for members on the Visibility Data Base is 1979. Other limitations are described in Paragraph 6.2.3.

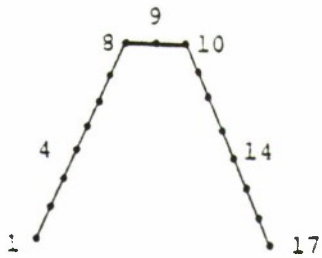
6.3 HOW TO USE CBMVM

The example used to illustrate this program is based on the A7E-01 crew station shown with the seated man-model as shown in Figure 4. The panels and edges of the A7E-01 crew station are combined to produce a visibility member consisting of three panels: the upper and lower windows, and the cockpit canopy. These panels are shown in Figure 120, along with the three-dimensional coordinates used to define points along the panel boundaries.

6.3.1 <u>Input Data Specification</u>

Input data format to CBMVM is similar to that of CBMCM, except that the adjacent panels and edges can be combined into panels for input to CBMVM.

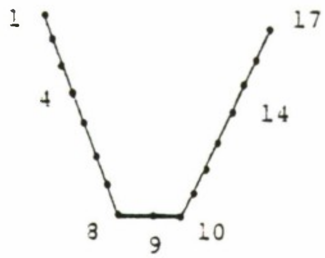
The program CBMCM is set up to accept any three dimensional cartesian coordinate system. The user must also supply the program with the three-dimensional coordinates of the Seat Reference Point (SRP) with respect to the origin of crew station coordinate system.



WINDSCREEN, FRONT TOP (17)

POINT:	x	y	z
1.	227.63	5.34	125.35
2.	223.79	5.51	123.24
3.	220.98	5.46	121.57
4.	218.93	5.19	120.59
5.	215.79	4.86	118.76
6.	213.14	4.27	117.35
7.	211.09	3.62	116.16
8.	209.14	2.31	115.34

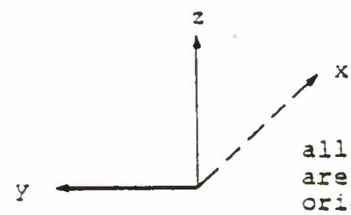
(Points 10-17 are the same as 8-1 with the sign of the y value changed)



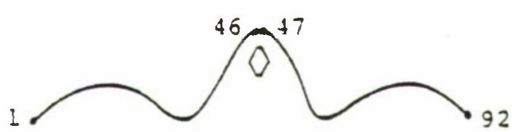
WINDSCREEN, FRONT BOTTOM (17)

POINT:	x	y	z
1.	227.63	5.34	125.35
2.	230.00	5.73	126.65
3.	232.12	5.68	127.34
4.	234.44	5.41	129.03
5.	237.31	4.70	130.59
6.	239.41	4.05	131.73
7.	241.09	2.92	132.36
8.	242.12	2.00	133.41
9.	242.12	0.00	133.41

(Points 10-17 are the same as 8-1 with the sign of the y value changed)



all Figs. are F,L,U orientation (COMBIMAN)



COCKPIT CANOPY CLEARLINE (92)

	x	y	z		x	y	z		x	y	z
1.	294.47	0.00	135.50	16.	286.78	19.41	116.98	31.	255.59	17.33	114.30
2.	294.04	2.47	134.60	17.	285.96	19.30	116.76	32.	254.69	16.97	114.60
3.	293.61	6.22	133.26	18.	284.71	19.30	116.54	33.	252.92	15.78	115.77
4.	293.22	8.32	132.01	19.	232.81	19.14	116.41	34.	251.92	14.70	117.45
5.	292.61	10.54	130.24	20.	281.34	19.08	116.29	35.	251.32	13.89	113.57
6.	292.09	12.43	128.60	21.	279.87	18.97	116.16	36.	250.69	13.35	119.70
7.	291.62	13.78	127.00	22.	277.67	18.86	115.94	37.	250.69	13.35	119.70
8.	291.14	15.03	125.57	23.	275.72	18.65	115.77	38.	249.55	11.78	122.38
9.	290.67	15.89	124.15	24.	273.35	18.49	115.55	39.	249.07	10.97	124.30
10.	290.02	17.30	122.38	25.	270.30	18.38	115.33	40.	248.73	10.16	125.50
11.	289.59	18.05	120.86	26.	268.94	18.82	115.16	41.	248.71	8.31	127.00
12.	289.07	18.86	119.44	27.	267.13	18.00	114.99	42.	247.32	7.34	123.50
13.	288.55	19.51	118.32	28.	264.97	17.39	114.86	43.	247.43	6.32	130.00
14.	287.95	19.46	117.71	29.	260.73	17.51	114.42	44.	247.08	4.97	132.00
15.	287.43	19.46	117.32	30.	258.53	17.24	114.95	45.	246.78	2.81	134.50
								46.	246.61	0.00	135.00

(Points 47-92 are the same as 45-1 with the sign of the y value changed)

Figure 120. X, Y and Z Coordinates of A7E-01 Boundaries.

Directions of the x, y, and z axes are A for Aft, F for Forward, L for Left, R for Right, U for Up, and D for Down. CBMVM converts the given coordinates to the COMBIMAN coordinate system (x=F, y=L, z=U, and SRP=(0,0,0)). (See Figure 120.)

The maximum number of vertices allowed for each panel of the crew station is 100. These vertices must be input consecutively, going either clockwise or counterclockwise along the perimeter of the panel as explained in Paragraph 6.3.2.1.

6.3.2 Processing Specification

The functions available to CBMVM users are the same as those for program CBMCM excluding the one to punch a member. The function request formats are punched one request per card and are shown in Figure 121. All control cards can be used anytime in any order except that the $INT card must be the first control card to initialize or re-initialize the Data Base. The format and necessary parameters of the control cards are explained in the following paragraphs.

6.3.2.1 ADD VISIBILITY MEMBER Function

&ADD membername type nbnds srpx srpy srpz x y z xx yy zz (followed by visibility member definition).

The ADD VISIBILITY MEMBER function adds the input data under the member name membername to the Visibility Data Base. The membername is limited to a length of eight characters. Type is a two-digit right justified integer that can be either 0 or 1. If type=0, the program checks the panel vertices for clockwise or counterclockwise entries. Type=1 avoids this test. Nbnds is a right justified three-digit integer, which specifies the number of panels associated with a membername. The SRP coordinates are srpx,

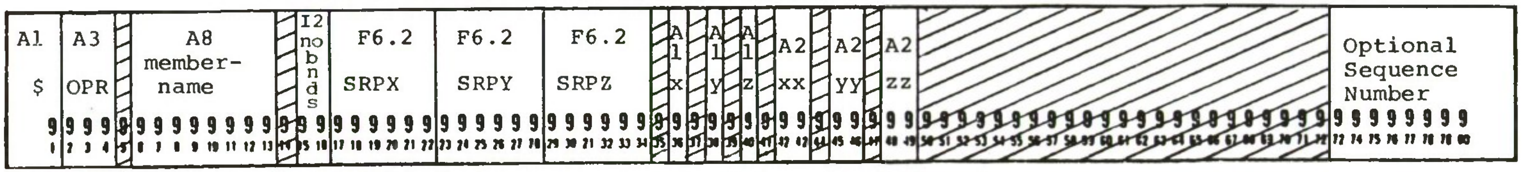


Figure 121. Program CBMVM Control Card Format.

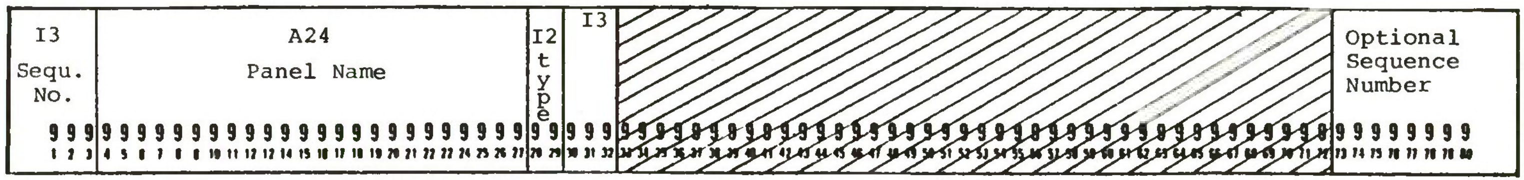


Figure 122. Program CBMVM Member Card Format for Panels.

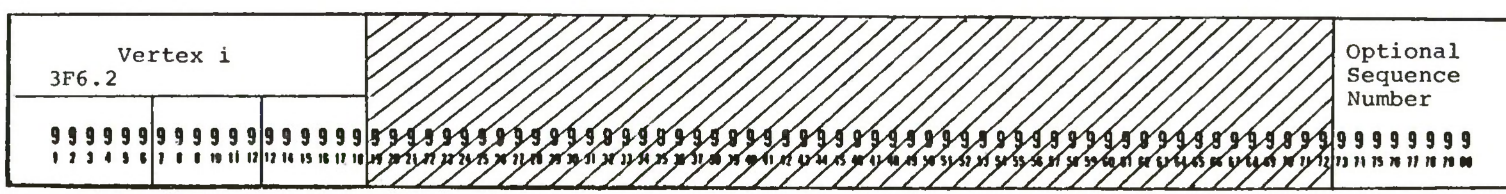


Figure 123. Program CBMVM Member Card Format for Coordinates of Panels.

srpy, and srpz and are entered as real numbers in F6.2 format. A decimal point, if omitted, is inserted by the program in between the second and third digits from the right. X, Y, and Z indicate the directions of the positive x, y, and z coordinates respectively, (A, F, L, R, U or D). xx, yy, zz are two letter abbreviations for the axis labels and directions of the input coordinate system when the operator is seated in the crew station. Examples of these values are FS (Fuselage Station-aft), WL (WaterLine-up), or BL (ButtLine-right).

Each panel is defined by a card containing its sequence number (seq.#), panelname, and number of coordinates (# coord) within the panel on one card and xyz coordinates of each vertex on separate cards. Figures 122 and 123 show the format for these input cards.

Seq.# and # coord are 3-digit right justified integers; the panelname can be up to 28 characters long. The three-dimensional coordinates of vertices are input as real numbers in F6.2 format, one set to a card. A decimal point, if omitted, is inserted between the second and the third digits from the right.

An example of the ADD VISIBILITY MEMBER function is shown in Figure 124. The first outlined area contains the &ADD control card. The associated panels consist of a panel name card (area 2) followed by the specified number of three-dimensional coordinate data cards shown in the third outlined area.

If the program detects an error in the input data the member will not be added to the Data Base.

```
&ADD A7E-01     3 270.6    0.0 99.15 F L U FS BL WL      1
001WINDSCREEN, FRONT BOTTOM      17                       2
 22763     584 12535
 22379     551 12324
 22098     546 12157
 21893     519 12059
 21579     486 11876
 21314     427 11735
 21109     362 11616                                       3
 20914     281 11584
 20914     000 11584
 20914    -281 11584
 21109    -362 11616
 21314    -427 11735
 21579    -487 11876
 21893    -519 12059
 22098    -546 12157
 22379    -551 12324
 22763    -584 12535
002WINDSCREEN, FRONT TOP         17
 22763     584 12535
 23000     578 12665
 23212     568 12784
 23444     541 12903
 23731     470 13059
 23941     405 13173
 24109     292 13286
 24212     200 13341
 24212     000 13341
 24212    -200 13341
 24109    -292 13286
 23941    -405 13173
 23731    -470 13059
 23444    -541 12901
 23212    -568 12784
 23000    -578 12665
 22763    -584 12535
003COCKPIT CANOPY CLEARLINE 1 92
 29447     000 13550
 29404     247 13460
 29361     622 13326
 29322     832 13201
 29261    1054 13024
 29209    1243 12860
 29162    1378 12700
 29114    1503 12557
 29067    1589 12415
 29002    1730 12238
             .
             .
             .
 29209   -1243 12858
 29261   -1054 13024
 29322   - 832 13201
 29361   - 622 13326
 29404   - 247 13460
 29447     000 13550
```

Figure 124. Sample Data for $ADD Member Function.

6.3.2.2 CHECK VISIBILITY MEMBER Function

&CHK membername type nbnds srpx srpy srpz x y z xx yy zz (followed by visibility crew station definition).

The CHECK VISIBILITY MEMBER function operates in the same way the ADD VISIBILITY MEMBER function does except that the member is not added, but is only checked for errors.

6.3.2.3 DELETE VISIBILITY MEMBER Function

&DEL membername

The DELETE VISIBILITY MEMBER function removes a given membername from the Data Base. In order to make the space occupied by the deleted member available, COMPRESS VISIBILITY DATA BASE function must be used.

6.3.2.4 COMPRESS VISIBILITY DATA BASE Function

&CMP

The COMPRESS VISIBILITY DATA BASE function compresses used space and maximizes the continuous unused space in the Visibility Data Base.

If the message "CBM527A NO SPACE, CANNOT ADD membername" is encountered during an &ADD operation, it is necessary to use compress function first and then attempt to add again. If the message reappears, the Data Base is full.

6.3.2.5 DUMP VISIBILITY MEMBER Function

&DMP membername or
&DMP

The DUMP VISIBILITY MEMBER function prints the contents of the specified visibility member membername or by default prints the entire Visibility Data Base if no member name is specified. The format of the output is as follows:

```
RECORD nn
+=+ first half of record in EBCDIC  +=+
+=+ second half of record in EBCDIC +=+
+=+ complete                        +=+
+=+       record                    +=+
+=+             in                  +=+
+=+               Hexadecimal       +=+
```

where:

nn - is the sequence number of the record on the Data Base and

+=+ - is delimeter for the data.

This function is primarily used as a debugging aid for Input/Output errors.

6.3.2.6 PRINT VISIBILITY MEMBER Function

&PRT membername or
&PRT

The PRINT VISIBILITY MEMBER function prints the data contained in the specified membername in a format similar to the input to the ADD VISIBILITY MEMBER function. Specifying no name or a nonexistent name causes a printout of the list of members and their extents on the Data Base, as well as the origin and orientations of their coordinate data.

6.3.2.7 INITIALIZE VISIBILITY MEMBER Function

&INT

The INITIALIZE VISIBILITY MEMBER function is used primarily to establish a Data Base, although it may be used to return the data base to its original unused state.

6.3.2.8 END PROGRAM Function

&END

The END PROGRAM function terminates execution of the program CBMVM.

6.3.3 Submitting a Processing Request

The sequence of Job Control Language (JCL) cards needed to execute the program CBMVM are shown in Figure 125. Initialization of the Data Base for the first time requires allocation of space on disk for the Data Base and is accomplished by the "//FT09F001 DD" cards shown in Figure 126 and the $INT control card initializes the Data Base. The "//FT09F001 DD" card in Figure 125 is used for all subsequent processing requests. The &END control card is always the last control card and it ends the program CBMVM.

6.3.4 Output Data Interpretation

Output generated by the program CBMVM, which controls page formatting and identifies each page with the source program name (CBMVM) , date, and time of program execution, and page number, falls into five format types.

```
//CBMVM     JOB HESS                                                  00001000
//JOBLIB    DD DSN=COMBIMAN.LOADLIB,DISP=SHR                          00001100
//CBMVM     EXEC PGM=CBMVM                                            00001200
//FT05F001  DD DDNAME=SYSIN                                           00001300
//FT06F001  DD SYSOUT=A                                               00001400
//FT07F001  DD SYSOUT=B                                               00001500
//FT09F001  DD DSN=COMBIMAN.VISDATA,DISP=SHR                          00001600
//SYSUDUMP  DD SYSOUT=A                                               00001700
//SYSIN     DD *                                                      00001800


            CBMVM FUNCTION CONTROL CARDS AND
               MEMBER DEFINITION DATA


/*
//                                                                    00001900
```

Figure 125. Job Control Cards to Execute CBMVM.

```
//FT09F001 DD DSN=COMBIMAN.VISDATA,UNIT=DISK,DISP=(NEW,CATLG),        00001600
//             VOL=SER=DISK01,SPACE=(240,2000),                       00001610
//             DCB=(BLKSIZE=240,LRECL=240,RECFM=FB)                   00001620
```

Figure 126. FT09F001 DD Card to Allocate Space for COMBIMAN.VISDATA and Execute Program CBMVM.

The first type of output is generated by the &INT, &CMP, &DEL and &END functions. The output for these functions indicates the start and end of processing associated with the specified function. The COMPRESS function, however, generates additional messages indicating that a certain member was, or was not, moved in the process of combining unused space. An example of this format, for the COMPRESS function, is shown in Figure 127.

The second type of output is generated by the PRINT function with a blank membername field. This causes a listing of the entries in the directory of the Data Base in the following format:

```
nn.) membername, EXTENT (n1, n2), nb PANELS,
                 ORIGIN = (x,y,z), ORIENT = (a,b,c),
                 AXES HEADINGS = (xx, yy, zz)
```

where:

nn	identifies the record number of the member within the directory
membername	is the 8 character name of the member at record nn
n1	is the location of first record of membername
n2	is the location of last record of membername
nb	is the number of panels associated with the member
x y z	is the location of the SRP in the original coordinate system
a b c	are the original orientation of the positive x, y and z axes, respectively.
xx yy zz	are the original axes headings for the positive x, y and z axes, respectively.

```
CBMVM --- VISIBILITY DATA BASE MAINTENANCE PROGRAM                    7/ 7/77  11.30. 0  PAGE   1

CBM500I &CMP
CBM528I BI-NAVOI WAS IN PLACE.
CBM528I A7E-01   WAS IN PLACE.
CBM538I COMPRESS FINISHED.
```

Figure 127. A Sample Output of &CMP Function.

```
CBMVM --- VISIBILITY DATA BASE MAINTENANCE PROGRAM                    7/ 7/77  8. 0.36  PAGE   9

CBM500I &PRT
         19.) BI-NAVIA, EXTENT=(        38,       46),   7 BOUNDARIES, ORIGIN=( 396.60,  22.00,  62.50), ORIENT.=(A,R,U)
                        AXES HEADINGS =(FS,BL,WL).
         20.) A7E-01   , EXTENT=(        31,       37),   3 BOUNDARIES, ORIGIN=( 270.60,   0.0 ,  99.15), ORIENT.=(F,L,U)
                        AXES HEADINGS =(FS,BL,WL).
         21.) BI-NAVOI, EXTENT=(        22,       30),   7 BOUNDARIES, ORIGIN=( 396.60,  22.00,  62.50), ORIENT.=(A,R,U)
                        AXES HEADINGS =(FS,BL,WL).
```

Figure 128. A Sample Output of &PRT Function.

This information was originally supplied to the Data Base by the &ADD control card. An example of the output of the &PRT function is shown in Figure 128.

The third type of output is generated by the DUMP function. For the member specified on the &DMP control card, the directory information in the second format is printed first. It is followed by records of the member printed in the format shown in Paragraph 6.3.2.5. The record in EBCDIC is printed in a 30A4 format and for the hexadecimal output, 15Z8 format is used.

The DUMP function is used primarily as a debugging aid for Input/Output errors. An example of the DUMP functon output is shown in Figure 129.

The fourth output format is used by the CHECK and ADD functions. The first item printed out is a reformatting of the information on the control card. Then, each panel definition along with its input and absolute coordinates are printed. The format is:

<u>nn</u>.) <u>bndnm</u>,<u>nv</u> VERTICES - INPUT COORD--ABSOLUTE COORD--

(x_{11}, y_{11}, z_{11}) to (x_{21}, y_{21}, z_{21})

" " " " " "

" " " " " "

$(x_{1nv}, y_{1nv}, z_{1nv})$ to $(x_{2nv}, y_{2nv}, z_{2nv})$

where:

<u>nn</u>	is the panel sequence number
<u>bndnm</u>	is the boundary name (8 characters or less)
<u>nv</u>	is the number of vertices for the panel
x_{1i}, y_{1i}, z_{1i}	coordinate of ith vertex of the panel in the original system of coordinates (i=1,nv)
x_{2i}, y_{2i}, z_{2i}	coordinates of the ith vertex of the panel, converted to the COMBIMAN coordinate system (i=1,nv)

```
C8M5001 &DMP A7E-01
             20.) A7E-01   , EXTENT=(       31,       37),    3 BOUNDARIES, ORIGIN=( 270.60,    0.0 ,   99.15), ORIENT.=(F.L.J)
                                AXES HEADINGS =(FS,BL,WL).
          RECORD    31
+=+    WINDSCREEN, FRONT BOTTOM          B B  )       B       5     B      *   , B  '        B    (8     8          B              +=+
+=+B     5B     8              B   A 5B    B    A       B    A       B    A(      B  'A       B    A *   , B    A  5    8 8 A)        +=+

+=+00000001E6C9D5C4E2C3D9C5C5D56B40C6D9D6D5E340C206E3E3060400000008080000011C22AFE49415D70A3421A3333C22ECF53415828F542181704+=+
+=+C2319FAF41575C2842166B85C233AB7C41530A3D421570A4C236CF53414DC28F42139C29C239758941445 1E8421233 33C23882864139EB854211028F+=+
+=+C23D75894 12CF5C2421380A4C23D7589000000004210 80A4C230758 9C12CF5C2421080A4C2308286C139EB8542 11028FC23975B9C1445 1EB421233 33+=+
+=+C236CF53C140E8854213 9C29C233AB7CC1530A304215 70A4C2319EAFC1575C284216 6B85C22ECF53C1562 8F542 18170AC22AF849C15D70A3421A3333+=+
          RECORD    32
+=+    WINDSCREEN, FRONT TOP             8 B  )       B      *      8   Q        B       *     B    .        B           =B        B+=+
+=+B  Q          B  Q          B   QA    B    A       BB    A      =B    A.      B    A   *     B  JA        B     A*       8 8 A)        +=+

+=+00000002E6C9D5C4E2C3D9C5C5D56840C609D6D5F340E3D6D740404000000000800000011C22AFE4941 5D70A3421A3333C2289990415C7AE142108000+=+
+=+C2267AD8415AE147421C8014C22428FD41568F5C421DE148C2214A3441483333421F70A4C21F309841 4JCCCC4220947 8C2108286412E88514221 85C2+=+
+=+C21C7AD8412000004222428FC21C7A080000000042224 28FC21C7A08C1 2880004 2224 28FC21082 86C12E8851422185C2C21F3098C140CCCC42209478+=+
+=+C2214A34C14B3333421F70A4C22428EDC1568F5C42100C29C2267A08C15AE147421C80A4C2289990C15C7AE142108000C22AF849C15D70A3421A3333+=+
          RECORD    33
+=+    COCKPIT CANOPY CLEARLINE          *                                                        P       '  F                   R +=+
+=+        O    ,    O          ,  )                B    G           3               8    *   M    B              5  M= 5C     )      +=+

+=+0000000 3C3D6C3D2D7C9E340C3C1D5D6D7E840C303C5C1D9D3C905C5000000010 0000 0 5 24217DEC0000000004224599A421770A04127851E4223733 1+=+
+=+4217029041638 51E4222 1C2942169EC041851E8842200C29421602904 1A8A3D7421F17 0A4215 7D7041C6E14742107333421505204 10C7AE1421 8D99A+=+
+=+42148A4041F07AE1421A6885421411F041FE3D70421900004213688042114CCC42173AE14212F07042120CCC42158 5C2421278504212DC2842144A30+=+
+=+4211F330421382 8F4213288542115 9A0421375C242128F5C42100480421375C2421228 8542102E10421368F5421104784 1F5C300421 34CCC42119C29+=+
          RECORD    34
+=+  C    )        C*     P       P            P      B                                      '            /     A      J      A         +=+
+=+A      TP   * A         4 OAA          1  AO  -       2 -A       8  7  B            B          ) 8          , B      N       8      N    +=+

+=+41E1C30042134CCC4211 70A441C35C004213230 7421142EF41AB070042131 47A42112307419452004 21 F8514211028F41711F084212DC284210CA30+=+
+=+4151EC004212A6664210 9E184 12C00004212 7D70421066664033300042 12614742102E14C11A8F004212D1E34210028FC137850042120000 41FD70A0+=+
+=+C15A14004211E3D741FB5C20C19DE8004211828F41F451F0C1C11F00421130 7041F199A0C1F0286042110 7AE41F26660C1FE8ED04 210F85141F73330+=+
+=+C211AF0841FC7AF142109E88C212AE0841E8333342124CCDC21347A541DE3070421368 85C213EE084105999942148CCDC213FE084105999942148CCD+=+
          RECORD    35
+=+B   D            8               B      *      8       58   R B G   '      B   '      R B            R B JS   5B     8           R 8 JSA 5B      +=+
+=+B    A        R B   'A        R B G A'         B     A 58   R B    A   *     B     A          B  OA          B    AN         B     A       , B     A        )  +=+

+=+C2150CC441BC7AE142173AE1C21587A541AF851E42192666C2150EAF41A28F5C421A599AC21663CE418CF5C24218099AC216C7A5417D70A3421D599A+=+
+=+C217287C41651FB8421ED99AC2178516414F851E42200 99AC21701E2412CF5C24223599AC217FD6800000000422 3099AC21701E2C12CF5C24223599A+=+
+=+C2178516C14F851E4220D99AC21728 7CC1651EB8421E099AC216C7A5C17070A34210599AC21663CEC18CF5C24210D99AC2150EAFC1A28F5C421A599A+=+
+=+C21587A5C1AF851F421926 56C2150CC4C18C7AE142173AE1C213EE08C105999942148CCDC21347A5C1DE3D7042136B85C212AE08C1E8333342124CCD+=+
          RECORD    36
+=+B     A           A     B  B   7   AO -B       2 -APP  B          AA    8      1    A     B       4   A=    B       7P  A)    B TP    * A      8              A      B               +=+
+=+       B  /                8  '         B                   B                B  8            P  8             C*  B    P          C  B )        5C  B  )                B    5    M=+=+

+=+C211B098C1FC7AE142109E88C1FE8E00C210F85141F73330C1F02860C21107AE41F26660C1070700C21130A341EFAE10C1C11F00C211307041F199A0+=+
+=+C190E800C21182 8F41F47AE0C17E1400C21 8AF141F70710C1504800C211E3D741FB5C20C1378500C212000041FD70A0C11A8F00C2123851421002 8F+=+
+=+4033 3000C21261474210 2E14412C0000C212707842106666 4151EC00C212A6664210 9EB14171 1F00C212DC2842 10CA3041945200C212F8514211028F+=+
+=+41AB0700C21314 7A4211214841C35C00C2132307421142 8F41E1C300C2134CCC4211 70A441F5C300C2134CCC42119C29421 02E10C21368F54211047B+=+
```

Figure 129. A Sample Output of &DMP Function.

An example of the output generated by the &ADD function is shown in Figure 130.

The fifth and last format is used by the PRINT function output. In this output the original input coordinates are not printed. The directory information is printed first and is followed by the panel definition data.

<u>nn</u>.) <u>bndnm</u>, <u>nv</u> VERTICES -- ABSOLUTE COORDINATES

$$(x_1, y_1, z_1)$$
$$\vdots \quad \vdots \quad \vdots$$
$$(x_{nv}, y_{nv}, z_{nv})$$

where:

<u>nn</u> — is the panel sequence number

<u>bndnm</u> — is the panel name (8 characters or less)

<u>nv</u> — is the number of vertices which constitute the panel

An example of this format is shown in Figure 131.

6.4 PROGRAM MESSAGES - INCLUDING ERROR CORRECTION

The program CBMVM prints out information and action related messages. The message format is:

CBM5nni <u>message text</u>

where:

<u>nn</u> — is the message number

<u>i</u> — indicates the action code (I=informational, A=action to be performed).

<u>message text</u> — is the text of the message.

```
CBM500I CADD A7E-01      3270.60  0.0  99.15 F L U FS BL WL
CBM519I MEMBER, A7E-01   , HAS    3 BOUNDARIES.
CBM520I COORDINATES ARE TRANSLATED TO ( 270.60,     0.0  ,   99.15).
CBM521I COORDINATES GIVEN AS F, L AND U ARE NOW F, L, AND U.
CBM522I AXES HEADINGS ARE FS, BL AND WL.
        1.) WINDSCREEN, FRONT BOTTOM TYPE= 0  17 VERTICES --INPUT COORDINATES---     --ABSOLUTE COORDINATES-
                                             ( 227.63   5.84 125.35)  TO  ( -42.97    5.84   26.20)
                                             ( 223.79   5.51 123.24)  TO  ( -46.81    5.51   24.09)
                                             ( 220.98   5.46 121.57)  TO  ( -49.62    5.46   22.42)
                                             ( 218.93   5.19 120.59)  TO  ( -51.67    5.19   21.44)
                                             ( 215.79   4.86 118.76)  TO  ( -54.81    4.86   19.61)
                                             ( 213.14   4.27 117.35)  TO  ( -57.46    4.27   18.20)
                                             ( 211.09   3.62 116.16)  TO  ( -59.51    3.62   17.01)
                                             ( 209.14   2.81 115.84)  TO  ( -61.46    2.81   16.69)
                                             ( 209.14   0.0  115.84)  TO  ( -61.46    0.0    16.69)
                                             ( 209.14  -2.81 115.84)  TO  ( -61.46   -2.81   16.69)
                                             ( 211.09  -3.62 116.16)  TO  ( -59.51   -3.62   17.01)
                                             ( 213.14  -4.27 117.35)  TO  ( -57.46   -4.27   18.20)
                                             ( 215.79  -4.87 118.76)  TO  ( -54.81   -4.87   19.61)
                                             ( 218.93  -5.19 120.59)  TO  ( -51.67   -5.19   21.44)
                                             ( 220.98  -5.46 121.57)  TO  ( -49.62   -5.46   22.42)
                                             ( 223.79  -5.51 123.24)  TO  ( -46.81   -5.51   24.09)
                                             ( 227.63  -5.84 125.35)  TO  ( -42.97   -5.84   26.20)
        2.) WINDSCREEN, FRONT TOP     TYPE= 0  17 VERTICES --INPUT COORDINATES---     --ABSOLUTE COORDINATES-
                                             ( 227.63   5.84 125.35)  TO  ( -42.97    5.84   26.20)
                                             ( 230.00   5.78 126.65)  TO  ( -40.60    5.78   27.50)
                                             ( 232.12   5.68 127.84)  TO  ( -38.48    5.68   28.69)
                                             ( 234.44   5.41 129.03)  TO  ( -36.16    5.41   29.88)
                                             ( 237.31   4.70 130.59)  TO  ( -33.29    4.70   31.44)
                                             ( 239.41   4.05 131.73)  TO  ( -31.19    4.05   32.58)
                                             ( 241.09   2.92 132.86)  TO  ( -29.51    2.92   33.71)
                                             ( 242.12   2.00 133.41)  TO  ( -28.48    2.00   34.26)
                                             ( 242.12   0.0  133.41)  TO  ( -28.48    0.0    34.26)
                                             ( 242.12  -2.00 133.41)  TO  ( -28.48   -2.00   34.26)
                                             ( 241.09  -2.92 132.86)  TO  ( -29.51   -2.92   33.71)
                                             ( 239.41  -4.05 131.73)  TO  ( -31.19   -4.05   32.58)
                                             ( 237.31  -4.70 130.59)  TO  ( -33.29   -4.70   31.44)
                                             ( 234.44  -5.41 129.01)  TO  ( -36.16   -5.41   29.86)
                                             ( 232.12  -5.68 127.84)  TO  ( -38.48   -5.68   28.69)
                                             ( 230.00  -5.78 126.65)  TO  ( -40.60   -5.78   27.50)
                                             ( 227.63  -5.84 125.35)  TO  ( -42.97   -5.84   26.20)
        3.) COCKPIT CANOPY CLEARLINE TYPE= 1  92 VERTICES --INPUT COORDINATES---     --ABSOLUTE COORDINATES-
                                             ( 294.47   0.0  135.50)  TO  (   23.87   0.0    36.35)
                                             ( 294.04   2.47 134.60)  TO  (   23.44   2.47   35.45)
                                             ( 293.61   6.22 133.26)  TO  (   23.01   6.22   34.11)
                                             ( 293.22   8.32 132.01)  TO  (   22.62   8.32   32.86)
                                             ( 292.61  10.54 130.24)  TO  (   22.01  10.54   31.09)
                                             ( 292.09  12.43 128.60)  TO  (   21.49  12.43   29.45)
                                             ( 291.62  13.78 127.00)  TO  (   21.02  13.78   27.85)
                                             ( 291.14  15.03 125.57)  TO  (   20.54  15.03   26.42)
                                             ( 290.67  15.89 124.15)  TO  (   20.07  15.89   25.00)
```

Figure 130. A Sample Output of CBMVM &ADD Function.

```
CBM500) &PRT A7E-01
        20.) A7E-01   , EXTENT=(        31,        37),    3 BOUNDARIES, ORIGIN=( 270.50,    0.0 ,   99.15), ORIENT.=)F.L.U)
                      AXES HEADINGS =)FS,BL,WL).
          1.) WINDSCREEN, FRONT BOTTOM TYPE= 0  17 VERTICES --ABSOLUTE,COORDINATES-
                                                          ( -42.97   5.84  26.20)
                                                          ( -46.81   5.51  24.09)
                                                          ( -49.62   5.46  22.42)
                                                          ( -51.67   5.19  21.44)
                                                          ( -54.81   4.86  19.61)
                                                          ( -57.46   4.27  18.20)
                                                          ( -59.51   3.62  17.01)
                                                          ( -61.46   2.81  16.69)
                                                          ( -61.46   0.0   16.69)
                                                          ( -61.46  -2.81  16.69)
                                                          ( -59.51  -3.62  17.01)
                                                          ( -57.46  -4.27  18.20)
                                                          ( -54.81  -4.87  19.61)
                                                          ( -51.67  -5.19  21.44)
                                                          ( -49.62  -5.46  22.42)
                                                          ( -46.81  -5.51  24.09)
                                                          ( -42.97  -5.84  26.20)
          2.) WINDSCREEN, FRONT TOP     TYPE= 0  17 VERTICES --ABSOLUTE,COORDINATES-
                                                          ( -42.97   5.84  26.20)
                                                          ( -40.60   5.78  27.50)
                                                          ( -38.48   5.68  28.69)
                                                          ( -36.16   5.41  29.88)
                                                          ( -33.29   4.70  31.44)
                                                          ( -31.19   4.05  32.58)
                                                          ( -29.51   2.92  33.71)
                                                          ( -28.48   2.00  34.26)
                                                          ( -28.48   0.0   34.26)
                                                          ( -28.48  -2.00  34.26)
                                                          ( -29.51  -2.92  33.71)
                                                          ( -31.19  -4.05  32.58)
                                                          ( -33.29  -4.70  31.44)
                                                          ( -36.16  -5.41  29.86)
                                                          ( -38.48  -5.68  28.69)
                                                          ( -40.60  -5.78  27.50)
                                                          ( -42.97  -5.84  26.20)
          3.) COCKPIT CANOPY CLEARLINE TYPE= 1  92 VERTICES --ABSOLUTE,COORDINATES-
                                                          (  23.87   0.0   36.35)
                                                          (  23.44   2.47  35.45)
                                                          (  23.01   6.22  34.11)
                                                          (  22.62   3.32  32.86)
                                                          (  22.01  10.54  31.09)
                                                          (  21.49  12.43  29.45)
                                                          (  21.02  13.78  27.85)
                                                          (  20.54  15.03  26.42)
                                                          (  20.07  15.89  25.00)
                                                          (  19.42  17.30  23.23)
                                                          (  18.99  18.05  21.71)
                                                          (  18.47  18.86  20.29)
```

Figure 131. A Sample Output of CBMVM &PRT Function.

CBM500I control card image

Reason:	User has submitted a control card.
System Action:	Reads the control card.
User Action:	None.

CBM501A operation UNKNOWN OPERATION.

Reason:	The operation on the control card (shown in the previous CBM500I message) is unknown.
System Action:	This control card is ignored.
User Action:	Correct the card and resubmit.

CBM503A vertexnumber INVALID VERTEX NUMBER FOR POINT panelname.

Reason:	The order in which the vertices are given is not in a clockwise or counterclockwise direction.
System Action:	Vertex number 1 is used.
User Action:	Delete the member, correct the error and resubmit.

CBM505A NO NAME GIVEN, operation IGNORED.

Reason:	This operation requires a member name, but none was supplied.
System Action:	The operation is ignored.
User Action:	Supply the member name and resubmit.

CBM506A membername NOT FOUND.

Reason:	For the Delete function (&DEL), Dump function (&DMP), or Print function (&PRT) the specified visibility member name does not exist.
System Action:	The directory of the visibility data base is printed, instead of performing the requested function.
User Action:	Check the control card for nonexistent member name.

CBM507A NUMBER OF PANELS INVALID FOR MEMBER membername.

Reason:	The number of panels as specified on the ADD function control card (&ADD) is either less than 1 or greater than 15.
System Action:	The control card is ignored.
User Action:	Correct and resubmit.

CBM508A axis FOR X INVALID, MEMBER IS membername.

Reason:	During the Add function (&ADD) the direction of the user's X-axis is not F, A, L, R, U or D.
System Action:	The control card is ignored.
User Action:	Correct and resubmit.

CBM509A axis FOR Y INVALID, MEMBER IS membername.

Reason:	During the Add function (&ADD), the direction of the user's Y-axis is not F, A, L, R, U or D.
System Action:	The control card is ignored.
User Action:	Correct and resubmit.

CBM510A axis FOR Z INVALID, MEMBER IS membername.

Reason:	During the Add function (&ADD), the direction of the user's Z-axis is not F, A, L, R, U or D.
System Action:	The control card is ignored.
User Action:	Correct and resubmit.

CBM511A X&Y, X&Z OR Y&Z ARE COLLINEAR FOR MEMBER membername.

Reason:	The directions of two axes are the same (ex. X=L, Y=U, and Z=U).
System Action:	The control card is ignored.
User Action:	Pick unique directions for the axes and resubmit.

CBM512A DIRECTORY IS FULL, CANNOT ADD membername.

Reason:	No space is left in the Visibility Data Base directory to add an entry for this member. The directory can hold only 20 membernames.
System Action:	The control card is ignored.
User Action:	Delete one or more members, compress the Data Base, and resubmit.

CBM514A membername ALREADY EXISTS.

Reason:	User has tried to add a member definition under a name that exists in the Data Base.
System Action:	The control card is ignored.
User Action:	Use a new name, and resubmit.

CBM515A END OF DATA.

Reason:	The end of file was found before the END Program control card (&END).
System Action:	The program is ended.
User Action:	Check to make sure that all the control cards are processed.

CBM516A I/O ERROR ON RECORD recordnumber (INDEX).

Reason:	An I/O error occurred on the Visibility Data Base.
System Action:	Terminates the program.
User Action:	Contact Systems Programmer.

CBM517A I/O ERROR ON RECORD recordnumber (DATA).

Reason:	An I/O error occurred on the Visibility Data Base.
System Action:	Terminates the program.
User Action:	Contact systems programmer.

CBM519I NEW MEMBER, membername, HAS nn PANELS.

Reason:	The user has added a member definition to the Data Base.
System Action:	The addition is accepted.
User Action:	None.

CBM520I COORDINATES ARE TRANSLATED TO seat reference point coordinate.

Reason:	The user added a member definition to the Data Base.
System Action:	The addition is accepted.
User Action:	None.

CBM521I COORDINATES GIVEN AS axis, axis AND axis ARE NOW F, L, and U.

Reason:	The user added a member definition to the Data Base.
System Action:	The addition is accepted.
User Action:	None.

CBM522I AXES HEADINGS ARE xx, yy, AND zz.

Reason:	The user added a member definition to the Data Base.
System Action:	The addition is accepted.
User Action:	None.

CBM523I membername DELETED.

Reason:	The user submitted a DELETE function control card (&DEL).
System Action:	The membername is deleted.
User Action:	None.

CBM524I INITIALIZED.

Reason:	The user requested that the Visibility Data Base be initialized using the Initialize Visibility Data Base Function (&INT).
System Action:	The Data Base is initialized.
User Action:	None.

CBM527A NO SPACE, CANNOT ADD membername.

Reason:	There is not enough space in the data base to hold the requested addition.
System Action:	The control card is ignored.
User Action:	Compress the Data Base and resubmit.

CBM528I membername WAS IN PLACE.

Reason:	The user requested the Data Base be compressed. The member, membername was already compressed, and not moved.
System Action:	The member was not moved.
User Action:	None.

CBM529I membername NOW IN PLACE.

Reason: The user requested the Data Base be compressed, the member, membername was not in place, and therefore was moved.

System Action: The Data Base is compressed.

User Action: None.

CBM531A panelname HAS SAME NUMBER AS panelname.

Reason: While adding a contour definition, two panels have the same panel number.

System Action: Both panels are accepted. Note that references to the second will cause a reference to the first.

User Action: Delete the member definition, correct the error, and resubmit.

CBM532I PROGRAM END.

Reason: The End Program function control (&END) card, or an end of file is encountered, or there is an I/O error, or there is an unknown operation.

System Action: Terminates program.

User Action: Make sure that all control cards are accepted, and processed correctly.

CBM534I membername WITH nn PANELS HAS BEEN ADDED.

Reason: Member has been successfully added.

System Action: Reads next control card.

User Action: None.

CBM535A membername NOT ADDED DUE TO nn ERRORS.

Reason: During &ADD operation, the system found nn errors.

System Action: Reads next control card; member is not added.

User Action: Correct error and resubmit.

CBM536I MEMBER membername CHECKED, nn ERRORS.

Reason: During &CHK, the system found nn errors.

System Action: Reads next control card.

User Action: Correct and resubmit.

CBM537A DATA BASE IS NOT VISIBILITY DATA BASE.

Reason: First record in directory contains a keyword 'IVIS' to identify a Visibility Data Base. We accessed a data set without that keyword.

System Action: Terminates program.

User Action: Check JCL cards and access correct data set.

APPENDIX A

COMBIMAN DISTRIBUTION TAPE DOCUMENTATION

A. CONTENTS

COMBIMAN DISTRIBUTION TAPE IS AN IBM STANDARD LABEL, NINE TRACK,1600BPI, DENSITY=3, PARITY=ODD, IEHMOVE TAPE CONTAINING TWO PARTITIONED DATA SETS AND SIX SEQUENTIAL DATA SETS. THE VOLUME SERIAL FOR THE DISTRIBUTION TAPE TAPE IS CBMTPE. THE DATA CONTROL BLOCK PARAMETERS OF THE DATA SETS ARE DESCRIBED IN THE FOLLOWING TABLE.

DATASET	FILE	LRECL	RECFM	BLKSIZE	ORGANIZATION
COMBIMAN.TPDOCMNT	1	80	FB	3200	SEQUENTIAL
COMBIMAN.LOADLIB	2		U	13030	PARTITIONED
COMBIMAN.DSTRBSRC	3	80	FB	3200	PARTITIONED
COMBIMAN.ANTHDATA	4	248	FB	248	SEQUENTIAL
COMBIMAN.CRSTDATA	5	368	FB	368	SEQUENTIAL
COMBIMAN.INITDATA	6	150	VBS	3200	SEQUENTIAL
COMBIMAN.SMPLANTH	7	80	FB	3200	SEQUENTIAL
COMBIMAN.VISDATA	8	240	FB	240	SEQUENTIAL

THE FIRST FILE ON THE TAPE IS A SEQUENTIAL FILE AND CONTAINS THE DESCRIPTION OF THE DATA SETS ON THE TAPE AND THE INSTALLATION PROCEDURE IN CARD IMAGE FORMAT.

THE SECOND FILE CONTAINS THE LOAD MODULES CBMC5, CBMAM, CBMCM, AND CBMVM AS MEMBERS OF THE PARTITIONED DATA SET COMBIMAN.LOADLIB. LINK EDIT MAPS OF THESE LOAD MODULES ARE GIVEN IN APPENDIX B-1, -2, -3, AND -4.

FILE 3 CONTAINS SOURCE MODULES CBMCP2, CBMCP3, CBMCP4, CBMVS1, CBMOFF, CBMCM, AND CBMOFF AS MEMBERS OF A PARTITIONED DATA SET COMBIMAN.DSTRBSRC. THE GRAPHIC SUBROUTINE CALLS IN CBMCP2, CBMCP3, CBMCP4, CBMVS1, AND IBMGLD ARE WRITTEN TO BE EXECUTED ON AN ON-LINE GOULD 5000 ELECTROSTATIC PLOTTER. THE USERS MAY HAVE TO CHANGE THESE CODES AND COMPILE AND LINK EDIT THESE SUBROUTINES TO CBMC5 TO USE THE PLOTTER AT THEIR SITE. CBMOFF, THE FIFTH MEMBER, IS THE OFFLINE PLOT ROUTINE. IT USES DATA GENERATED ON UNIT 11 DURING A COMBIMAN RUN WHEN PFK7 IS ACTIVATED TO GET AN OFF-LINE PLOT OF COMBIMAN. THE CODE IN CBMOFF MODULE IS WRITTEN FOR A CALCOMP PLOTTER DRIVEN BY A CDC COMPUTER. THE SIXTH MEMBER, CBMCM, HAS THE SOURCE LISTING OF THE MAIN ROUTINE WHICH MAINTAINS THE CREW STATION DATA BASE (CBMCOM). THIS MODULE MAY BE ALTERED TO SUIT THE DATA ENTRY OR DIGITIZING PROCEDURES AT THE USER'S FACILITIES TO ADD NEW CREW STATION DATA OR TO MODIFY EXISTING MEMBERS. THE SEVENTH MEMBER IN THE DATA SET IS THE SOURCE LISTING OF THE ASSEMBLER SUBROUTINE IBMGLD. IBMGLD IS CALLED FROM THE

SUBROUTINE GSPGLC TO CONVERT THE IBM 2250 GRAPHIC ORDERS TO GOULD TYPE PLOT ORDERS. LISTINGS OF THESE SOURCE MODULES ARE GIVEN IN APPENDIX C.

FILES 4 THROUGH 8 ARE SEQUENTIAL DATA SETS AND CONTAIN DATA NECESSARY TO EXECUTE CBMC5. IN FILE FOUR THE DATA SET COMBIMAN.ANTHDATA, DESCRIBED IN SECTION 4, HAS THE ANTHROPO-METRIC SURVEY AND REGRESSION DATA FOR 1967 USAF PILOTS, 1968 USAF WOMEN, 1968 USAF WOMEN FLYERS, 1964 US NAVY FLYERS, AND 1970 US ARMY PILOTS. THE JCL CARDS, PROGRAM CONTROL CARDS, AND DATA NECESSARY TO CREATE THIS DATA SET ARE LISTED IN APPENDIX D.

FILE 5 HAS THE COMBIMAN.CRSTDATA DATA SET WHICH CONTAINS THE SEAT, PANEL, AND CONTROL DATA FOR THE A7E-01 CREW STATION CONFIGURATION. THE JCL CARDS, CONTROL CARDS, AND DATA USED TO CREATE THIS DATA SET ARE IN APPENDIX E.

FILE 6 HAS THE DATA SET COMBIMAN.INITDATA WHICH CONTAINS DATA NECESSARY TO GENERATE THE COMBIMAN LINK SYSTEM AND PROMPT ING MESSAGES.

FILE 7 HAS THE DATA SET COMBIMAN.SMPLANTH WHICH CONTAINS 18 SETS OF SAMPLE ANTHROPOMETRY FOR THE CARD INPUT OPTION OF THE INPUT 12 ANTHROPOMETRIC DIMENSIONS FUNCTION (SEE SECTION 2.2.12 AND FIGURE 40 OF THE USER'S GUIDE).

FILE 8 HAS THE DATA SET COMBIMAN.VISDATA WHICH CONTAINS THE VISIBILITY DATA (SEE SECTION 6 OF COMBIMAN USER'S GUIDE) FOR THE A7E-01 CREW STATION CONFIGURATION. THE JCL CARDS, CON TROL CARDS, AND DATA USED TO CREATE THIS DATA SET ARE IN AP-PENDIX F.

B. INSTALLATION PROCEDURE

THE GENERAL PROCEDURE DESCRIBED HERE TO COPY A DATA SET FROM COMBIMAN DISTRIBUTION TAPE TO DISK CONSISTS OF TWO STEPS. THE FIRST STEP ALLOCATES SPACE FOR THE DATA SET TO DISK USING PGM=IEFBR14. THE SECOND STEP COPIES THE DATA SET TO DISK USING PGM=IEHMOVE. THIS PROCEDURE IS SUGGESTED BECAUSE THE UTILITY IEHMOVE MAY NOT ALLOCATE SUFFICIENT SPACE TO LOAD LARGE DATA SETS.

```
//ALLOCATE JOB
//ALLOC     EXEC  PGM=IEFBR14
//DD1       DD DSN=COMBIMAN.TPDOCMNT,DISP=(NEW,CATLG,DELETE),
//          SPACE=(TRK,(1,1)),UNIT=DISK,VOL=SER=VOLUME,
//          DCB=(RECFM=FB,LRECL=80,BLKSIZE=3200)
//
```

THE 'VOLUME' IN VOL=SER=VOLUME SHOULD BE CHANGED TO REFLECT THE DISK VOLUME.

THE DCB PARAMETERS FOR ALL THE DATA SETS ARE GIVEN IN THE TABLE IN SECTION A OF THIS APPENDIX. THE SPACE PARAMETERS FOR THE DATA SETS ARE:

DATASET	SPACE PARAMETER
COMBIMAN.TPDCOMNT	(TRK,(1,1))
COMBIMAN.LOADLIB	(TRK,(20,10,5))
COMBIMAN.SOURCE	(TRK,(5,1,2))
COMBIMAN.ANTHDATA	(248,2000)
COMBIMAN.CRSTDATA	(368,2000)
COMBIMAN.INITDATA	(TRK,(1,1))
COMBIMAN.SMPLANTH	(TRK,(1,1))
COMBIMAN.VISDATA	(240,2000)

THE JCL TO COPY A PARTITIONED DATA SET, COMBIMAN.LOADLIB, FROM CBMTPE FILE 2 IS:

```
//COPYPDS   JOB
//COPY      EXEC PGM=IEHMOVE
//SYSPRINT  DD SYSOUT=A
//SYSUT1    DD UNIT=SYSDA,SPACE=(TRK,(1,1)),DISP=OLD
//CBMTPE    DD UNIT=TAPE,VOL=(PRIVATE,RETAIN,SER=CBMTPE),
//             DISP=OLD
//CBMDSK    DD UNIT=DISK,VOL=SER=VOLUME,DISP=OLD
//SYSIN     DD *
 COPY PDS=COMBIMAN.LOADLIB,FROM=TAPE=(CBMTPE,2),TO=DISK=VOLUME
/*
//
```

THE JCL TO COPY A SEQUENTIAL DATA SET, COMBIMAN.ANTHDATA, FROM CBMTPE FILE 4 IS:

```
//COPYSEQ   JOB
//COPY      EXEC PGM=IEHMOVE
//SYSPRINT  DD SYSOUT=A
//SYSUT1    DD UNIT=SYSDA,SPACE=(TRK,(1,1)),DISP=OLD
//CBMTPE    DD UNIT=TAPE,VOL=(PRIVATE,RETAIN,SER=CBMTPE),
//             DISP=OLD
//CBMDSK    DD UNIT=DISK,VOL=SER=VOLUME,DISP=OLD
//SYSIN     DD *
 COPY DSNAME=COMBIMAN.ANTHDATA,FROM=TAPE=(CBMTPE,4),            *
               TO=DISK=VOLUME
/*
//
```

APPENDIX B-1

LINKAGE EDITOR MAP OF CBM05

```
//CBM05L   JOB  UCRI,PAPU,CLASS=C                                     JOB   40
//LKED     EXEC PGM=IEWL,REGION=120K,                                 00001100
//              PARM='LET,LIST,MAP,SIZE=(120K,20K)'                   00001200
//SYSLIB   DD   DSNAME=SYS1.FORTLIB,DISP=SHR                          00001300
//         DD   DSN=SYS1.LINKLIB,DISP=SHR                             00001400
//         DD   DSNAME=SYS1.FESSFORT,DISP=SHR                         00001500
//SYSUT1   DD   UNIT=SYSDA,SPACE=(7294,(20,20),RLSE),                 00001600
//              DCB=BLKSIZE=7294                                      00001700
//CBMLIB   DD   DSN=CCMBIMAN.OBJECT,DISP=SHR                          00001800
//SYSPRINT DD   SYSOUT=A                                              00001900
//SYSLMOD  DD   DSN=CCMBIMAN.LOADLIB,DISP=OLD                         00002000
//SYSLIN   DD   *                                                     00002100
```

```
F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LET,LIST,MAP,SIZE=(120K,20K)
         VARIABLE OPTIONS USED -   SIZE=(122880,20480)
IEW0000         ENTRY    CBMRTS                                             00002200
IEW0000         INCLUDE  SYSLIB(IHCGSP03)                                   00002300
IEW0000         INCLUDE  SYSLIB(SYMBOL,LINE,NUMBER,AXIS,SCALE,PLOTS,BTSTN48) 00002400
IEW0000         INCLUDE  CBMLIB(CBMABC,CBMASM,CBMBOX,CBMCP1,CBMCP2,CBMCP3,  100002500
                    CBMCP4,CBMCNS,CBMCNV,CBMCRW,CBMCS1,CBMCVW,CBMDAT,       200002600
                    CBMDEP,CBMDPL,CBMDSP,CBMENF,CBMENV,CBMEN1,CBMGQA,       300002700
                    CBMIDP,CBMINC,CBMINT,CBMIN1,CBMIOI,CBMJCT,CBMCPN,       400002800
                    CBMMLT,CBMPEF,CBMPFK,CBMPLN,CBMPNL,CBMPRT,CBMPSP,       500002900
                    CBMPST,CBMRCF,CBMRPY,CBMRP1,CBMRST,CBMRTS,CBMSSW,       600003000
                    CBMTGL,CBMTNG,CBMTRM,CBMVIS,CBMVS1,CBMXCC,CBMXHR,       700003100
                    CBMZMM,CRTDMP,GSPGLD,IBMGCD)                             00003200
IEW0000         NAME     CBM05(R)                                            00003300
```

MODULE MAP

CONTROL SECTION NAME	ORIGIN	LENGTH	ENTRY NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION
IHCGSPC3	00	15C								
			INDEV	00	IMDEV	4	INGDS	8	TMGDS	C
			CRATL	10	ENATL	14	ENAIN	18	DSATN	1C
			MPATL	20	MLPEO	24	SLPAT	28	MLITS	2C
			RQATN	30	EURATL	34	SETATN	38	SALRM	3C
			GSPRD	40	RCURS	44	ICURS	48	SDATM	4C
			SGRAM	50	SDATL	54	SGDSL	58	SSCIS	5C
			SCHAM	60	PLINE	64	PPNT	68	PSGMT	6C
			PTEXT	70	STPOS	74	MVPOS	78	BGSEQ	7C
			BGSLB	80	ENSEQ	84	ENSUB	88	LKSUB	8C
			INCL	90	OMIT	94	EXEC	98	RESET	9C
			IDPCS	A0	FSMOD	A4	STEOS	A8	ORGDS	AC
			LOCPN	B0	BGTRK	B4	ROTRK	B8	ENTRK	BC
			DFSIR	C0	PLSIR	C4	ORGEN	C8	CNVRT	CC
			ITRC	D0	ITBP	D4	RTBP	D8	ITST	DC
			SPEC	E0						
SYMBOL	160	9E0								
			WIDTHR	56A						
LINE	840	184								
NUMBER	CC8	1AC								
AXIS	E68	534								
SCALE	13A0	23C								
PLIPLOTS	15D0	F7C								
			PLOTS	15D0	FACTOR	1924	ERASE	1958	CLSOUT	1988
			WHERE	1980	LINEWT	19E8	LISTON	1A36	NOLIST	1A48
			OFFSET	1A5A	RESRV	1A88	PLOTI	1AC8	PLOT	1BA6
			GDSERR	2040						
PLIPT48	2540	58C								
			PLOTOCT	2546	PLOTOUTI	27C0				
PLIBITST	2AC0	189C								
			BITSET	2AD0	BITSETL	2AE4	BITRESRV	2AFE		
P2INR2	4670	DBC								
			BITINIT	4670	BITFORMAT	4676	BUFINIT	469A		

NAME	ORIGIN	LENGTH	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION
CRTDMP	3FC30	118								
GSPGLD	3FD48	38C								
IBMGLD	400D8	498								
IHCSLOG *	40570	1D4	ALOG10	40570	IH$ALOG0	40570	LOG10	40570	IH$ALOG	40588
			ALOG	40588	LOG	40588				
IHCFMAXP*	40748	E5	MAX1	40748	MIN1	4075E	AMAX1	40774	AMIN1	4078A
IHCSASCN*	40830	1F7	ARCOS	40830	ACOS	40830	IH$ARCOS	40830	ARSIN	40846
			ASIN	40846	IH$ARSIN	40846				
IHCSATN2*	40A28	1E8	ATAN2	40A28	IH$ATAN2	40A28	ATAN	40A3C	IH$ATAN	40A3C
IHCSSCN *	40C10	20E	COS	40C10	IH$$COS	40C10	SIN	40C32	IH$$SIN	40C32
IHCEDIOS*	40E18	EE2	DIOCS#	40E18						
IHCFRXPR*	41D00	198	FRXPR#	41D00						
IHCECOMH*	41EAC	EBC	IBCOM#	41ECC	IB081971	41ECC	FDIOCS#	41F88	INTSWTCH	42C88
FIOCAP# *	42C5C	6F4	AP081971	431C4						
IHCCOMH2*	43448	9C5	SEQCASD	43802						
IHCSSQRT*	43E10	168	SQRT	43E10	IH$SQRT	43E10				
IHCGSPC4*	43F78	2B8	BCNV	43F78						
IHCDBUG *	44230	801	DEBUG#	44230						
IHCSEXP *	44A38	18C	EXP	44A38	IH$$EXP	44A38				
IHCFRXPI*	44BE8	179	FRXPI#	44BE8						
IHCERRM *	44C68	624	ERRMON	44D68	IHOERRE	44D80				
IHCUATBL*	45390	638								
IHCGSPC1*	459C8	A2	INGSP	459C8						
IHCGSPC2*	45A70	EA	TMGSP	45A70						
WAITO *	45B60	8C								
IHCFCVTH*	45BF0	A43	ADCON#	45BF0	FCVAOUTP	45C9A	FCVLOUTP	45D2A	FCVZOUTP	45E86
			FCVIOUTP	46260	FCVEOUTP	46352	FCVCOUTP	46352	INT6SWCH	465B4
IHCEFNTH*	46638	80C	ARITH#	46638	ADJSWTCH	468CC				
IHCEFIOS*	46E38	118C	FIOCS#	46E38	FIOCSBEP	46E3E				
IHCFIOS2*	47FC8	642								
IHCUOPT *	48C10	33E								

NAME	ORIGIN	LENGTH	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION
CBMABC	5420	CC8								
CBMASM	6CE8	140A								
CBMBCX	74F8	81E								
CBMCP1	7D18	AFE2								
CBMCP2	12D00	7E2								
CBMCP3	134E8	2648								
CBMCP4	15B30	614								
CBMCNS	16148	2F6								
CBMCNV	16440	20C								
CBMCRW	16640	128C								
CBMCS1	178CC	892								
CBMCVW	18158	6BA								
CBMDAT	18818	FE								
CBMDEP	18918	1C8E								
CBMDPL	1A5A6	4FC								
CBMDSP	1AA98	40CC								
CBMENF	1EB68	FBE								
CBMENV	1FB28	28C6								
RDIST	223F0	19A								
DLINE	22590	19A								
CBMEN1	22730	C1C								
CBMGDA	23340	37E								
CBMIDP	236B8	B4C								
CBMIND	24208	402F								
CBMINT	28238	19CE								
CBMIN1	29C08	2B10								
CBMIOI	2C718	BC8								
CBMJCT	2D2E0	84E								
CBMLPN	2DB28	20E								
CBMMLT	2DD38	3FE								
CBMPEF	2E138	742								
CBMPFK	2E880	25C								
CBMPLN	2EAE0	1C3C								
CBMPNL	30718	832								
CBMPRT	30F50	BCA								
CBMPSP	31B20	63F								
CBMPST	32160	31F								
CBMRCH	32480	1F5C								
CBMRPY	343E0	626								
CBMRP1	34A08	2B2								
CBMRST	34CC0	32AC								
CBMRTS	37F60	72E								
CBMSSW	38688	5FE								
CBMTBL	38C80	934								
CBMTNG	395B8	E7C								
CBMTRM	3A438	384								
CBMVIS	3A7C0	26A6								
CBMVS1	3CE68	164E								
CBMXCL	3E4B8	2EE								
CBMXHR	3E7A8	FE8								
CBMZMM	3F790	49A								

NAME	ORIGIN	LENGTH	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION
IHCFCCNI*	48548	2FC	FQCCNI#	48548						
IHCFCCNO*	48C48	4C2	FQCCNC#	48C48						
IHCETRCH*	49110	2AE	IHOTRCH	49110	ERRTRA	49118				
IHCFTEN *	493CC	198	FTEN#	493C0						
CBMRGR	49558	4D78								
CBMREN	4E2D0	1B4								
CBMJCI	4E488	1EC								
CBMBDM	4E668	19B4								
CBMETN	50C20	4C								
CBMRCA	50C60	AC8								
CBMVSB	50E38	4E5C								
CBMGRA	55988	88								
CBMPDT	55A10	2C								
CBMXYZ	55A30	65CC								
CBMBXY	5BF30	410C								
CBMDAV	60C30	C								
CBMVEW	60C40	C8								
CBMBDS	60108	284E								
CBMRMV	62950	BBE								

ENTRY ADDRESS 37F60
TOTAL LENGTH 63508

****CBM05 DOES NOT EXIST BUT HAS BEEN ADDED TO DATA SET

APPENDIX B-2

LINKAGE EDITOR MAP OF CBMAM

```
//CBMAMLKD  JOB   UDRI,BAPU                                        JOB  17
//LKED      EXEC  PGM=IEWL,PARM=(LIST,MAP)                         00000200
//SYSLIB    DD    DSN=SYS1.FORTLIB,DISP=SHR                        00000300
//CEMLIB    DD    DSN=COMBIMAN.OBJECT,DISP=SHR                     00000400
//SYSPRINT  DD    SYSOUT=A                                         00000500
//SYSLMOD   DD    DSN=COMBIMAN.LOADLIB,DISP=SHR                    00000600
//SYSUT1    DD    UNIT=SYSDA,SPACE=(1024,(200,200))                00000700
//SYSLIN    DD    *                                                00000800
```

```
F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,MAP
         DEFAULT OPTION(S) USED -   SIZE=(92160,8192)
IEW0000         ENTRY     CBMAOM                                       00000900
IEW0000         INCLUDE   CEMLIB(CBMALM,CBMADP,CBMCAT)                 00001000
IEW0000         NAME      CBMAN(R)                                     00001100
```

MODULE MAP

```
CONTROL SECTION                  ENTRY

  NAME      ORIGIN  LENGTH         NAME      LOCATION    NAME      LOCATION    NAME      LOCATION    NAME      LOCATION

CBMADM        00     64C0
CBMADP      64C0      25C
CBMCAT      6720      15C
IHCEDIOS*   6880      EE2
                                 DIOCS#      6880
IHCECOMH*   7768      EBC
                                 IBCOM#      7794      IB081971    7794      FDIOCS#     7850      INTSWTCH    8550
FIOAP#  *   8618      6F4
                                 AP081971    8A8C
IHCCOMF2*   8D10      9C5
                                 SEQDASD     90CA
IHCFCVTH*   96D8      A43
                                 ADCON#      96D8      FCVAOUTP    9782      FCVLOUTP    9812      FCVZOUTP    996E
                                 FCVIOUTP    9D48      FCVEOUTP    9E3A      FCVCOUTP    9E3A      INT6SWCH    A09C
```

```
IHCFFNTH*   A120    800
                                  ARITH#      A120    ADJSWTCH    A6B4
IHLEFIOS*   A920    118C
                                  FIOCS#      A920    FIOCSBEP    A926
IHCFIOS2*   BABC    642
IHCERRM *   COF8    624
                                  ERRMON      COF8    IHCERRE     C110
IHCUATBL*   C720    638
IHCUOPT *   CD58    338
IHCFCVTI*   DC90    2FC
                                  FQCCNTA     CC9C
IHCFCCMC*   C390    4C2
                                  FQCCNC#     C390
IHCETRCH*   C858    2AE
                                  IHOTRCH     C858    ERRTRA      D860
IHCFTEN *   CC08    198
                                  FTEN#       CBC8
CBMADC      CCA0    2C

ENTRY ADDRESS        00
TOTAL LENGTH       CCC0

****CEMAN     DOES NOT EXIST BUT HAS BEEN ADDED TO DATA SET
```

APPENDIX B-3

LINKAGE EDITOR MAP OF CBMCM

```
//CBMCMLKO JOB  UURI,UAPU                                      JOB  46
//LKLO      EXEC PGM=IEWL,PARM=ILISI,MAP)                      00000200
//SYSLIB    DD   DSN=SYS1.FURTLIB,DISP=SHR                     00000300
//CBMLIB    DD   DSN=CCMBIMAN.OBJECT,DISP=SHR                  00000400
//SYSPRINT  DD   SYSOUT=A                                      00000500
//SYSLMOD   DD   DSN=CCMBIMAN.LOADLIB,DISP=SHR                 00000600
//SYSUT1    DD   UNIT=SYSDA,SPACE=(1024,(200,20))              00000700
//SYSLIN    DD   *                                             00000800
```

```
F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,MAP
      DEFAULT OPTION(S) USED -   SIZE=(92160,8192)
IEW0000        ENTRY     CBMCOM                                             00000900
IEW0000        INCLUDE   CBMLIB(CBMCOM,CBMCDP,CBMDAT,CBMDT3,CBMDT4,CBMTRN)  00001000
IEW0000        NAME      CBMCM(R)                                           00001100
```

MODULE MAP

CONTROL SECTION			ENTRY							
NAME	ORIGIN	LENGTH	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION	NAME	LOCATION
CBMCOM	00	E700								
CBMCDP	E700	24C								
CBMDAT	E950	15C								
CBMDT3	EABD	224								
CBMDT4	EC08	494								
CBMTRN	F170	2A2								
IHCEDICS*	F418	EE2	DIOCS#	F418						
IHCECCMH*	10300	EBC	IBCOM#	1032C	IB081971	1032C	FDIOCS#	103E8	INTSWTCH	110E8
FICAP# *	111B0	6F4	AP081971	11624						
IHCCOMH2*	118A8	9C5	SEQCASO	11C62						
IHCSSQRT*	12270	168	SQRT	12270	IH$SQRT	12270				
IHCFCVTH*	123D8	A43	ADCON#	12308	FCVAOUTP	12482	FCVLOUTP	12512	FCVZOUTP	1266E
			FCVIOUTP	12A48	FCVEOUTP	1283A	FCVCOUTP	1283A	INT6SWCH	1209C

```
IHCEFNTH*  12E20     800          ARITH#     12E20   ADJSWTCH   133B4
IHCEFIOS*  13620    118C          FIOCS#     13620   FIOCSBEP   13626
IHCFIOS2*  147B0     642
IHCERRM *  14CF8     624          ERRMON     14DF8   IHCERRE    14E10
IHCUATBL*  15420     638
IHCUOPT *  15A58     33E
IHCFCONI*  15C90     2FC          FCCONI#    15D90
IHCFCOND*  16C90     4C2          FCCOND#    16090
IHCETRCH*  16558     2AE          IHCTRCH    16558   ERRTRA     16560
IHCFTEN *  16808     198          FTEN#      16808
CBMWOC     169A0      2C

ENTRY ADDRESS        00
TOTAL LENGTH      169C0

****CBMCH     DOES NOT EXIST BUT HAS BEEN ADDED TO DATA SET
```

APPENDIX B-4

LINKAGE EDITOR MAP OF CBMVM

```
//CBMVMLKD JOB   CORI,EAPO                                        JOB  16
//LKED      EXEC PGM=IEWL,PARM=(LIST,MAP)                          00000200
//SYSLIB    DD   DSN=SYS1.FORTLIB,DISP=SHR                         00000300
//CBMLIB    DD   DSN=COMBIMAN.OBJECT,DISP=SHR                      00000400
//SYSPRINT  DD   SYSOUT=A                                          00000500
//SYSLMOD   DD   DSN=COMBIMAN.LOADLIB,DISP=SHR                     00000600
//SYSUT1    DD   UNIT=SYSDA,SPACE=(1024,(200,200))                 00000700
//SYSLIN    DD   *                                                 00000800


F88-LEVEL LINKAGE EDITOR OPTIONS SPECIFIED LIST,MAP
     DEFAULT OPTION(S) USED -   SIZE=(92160,8192)
IEW0000        ENTRY    CBMVDM                                          00000900
IEW0000        INCLUDE  CBMLIB(CBMVDM,CBMVDP,CBMCAT)                    00001000
IEW0000        NAME     CBMVM(R)                                        00001100

                                   MODULE MAP

CONTROL SECTION                ENTRY

  NAME     ORIGIN  LENGTH        NAME    LOCATION    NAME    LOCATION    NAME    LOCATION    NAME    LOCATION

CBMVDM        00    7EE4
CBMVDP      7EE8     27C
CBMCAT      8158     15C
IHCEOICS*   82B8     EE2
                               DIOCS#     82B8
IHCECOMH*   91A0     EBC
                               IBCOM#     91CC     IBOB1971    91CC    FDIOCS#     9288    INTSWTCH    9F88
FIOAP#  *   AC50     6F4
                               APOEI571   A4C4
IHCCOMF2*   A748     9C5
                               SEQDASD    AB02
IHCFCVTH*   B110     A43
                               ADCON#     B110     FCVAOUTP    B1BA    FCVLOUTP    B24A    FCVZOUTP    B3A6
                               FCVIOUTP   B780     FCVEOUTP    B872    FCVCOUTP    B872    INT6SWCH    BAD4
```

```
IHCEFNTH*   B858      800             ARITH#      B858    ADJSWTCH    C0EC
IHCEFIOS*   C358     118C             FIOCS#      C358    FIOCSBEP    C35E
IHCFIOS2*   D4E8      642
IHCERRM *   DB30      624             ERRMON      DB30    IHCERRE     D848
IHCUATBL*   E158      638
IHCUOPT *   E790      33E
IHCFCCNI*   EAC8      2FC             FQCCNI#     EAC8
IHCFCCND*   EDC8      4C2             FQCCNC#     EDC8
IHCETRCH*   F290      2AF             IHOTRCH     F290    ERRTRA      F298
IHCFTEN *   F540      198             FTEN#       F540
CBMVDC      F6C8       2C

ENTRY ADDRESS       00
TOTAL LENGTH      F6F8

****CBMVM     DOES NOT EXIST BUT HAS BEEN ADDED TO DATA SET
```

APPENDIX C-1

COMBIMAN SOURCE - CBMCP2 LISTING

```
      SUBROUTINE CBMCP2(X,Y)
C
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C
C     CBMCP2 - PLOTS MAN-MODEL AND CREW STATION ON GOULD PLOTTER
C
C        CALLED BY -
C              CBMCP1 - MAIN COMBIMAN PLOT ROUTINE
C              CBMCP4 - HEADING PLOT ROUTINE
C
C        CALLS -
C              PLOT   - CALCOMP ROUTINE (DRAW LINE)
C              SYMBOL - GOULD CHARACTER PLOT ROUTINE
C
C        OUTPUT TO -
C              UNIT  9 - PLOTTER DATA
C
C        PARAMETERS -
C              X - ARRAY OF X VALUES TO BE PLOTTED
C              Y - ARRAY OF Y VALUES TO BE PLOTTED
C
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C
C        COMMON  // CBMBXY //  MAN-MODEL XYZ DATA
C              PROJECTED ENFLESHMENT ELLIPSOID SURFACE POINTS - XYZ.
C              INDEX ARRAY TO DEFINE RELATIONSHIP BETWEEN POINTS AND
C              LINKS.
C              INDEX ARRAY TO XYZ'S TO LOCATE TANGENT LINE ENDPOINTS.
      INTEGER XYZK
      COMMON /CBMBXY/ XYZEN(3,1000),XYZK(1000),MINTAN(2,40),
     1       MAXTAN(2,40)
C
C        COMMON  // CBMXYZ //  MAN-MODEL AND WORKSPACE XYZ DATA
C              MAN-MODEL JOINT AND ELLIPSE CENTERS (NEUTRAL AND
C              PROJECTED).
C              WORKSPACE PANEL XYZ DATA.
C              KEY TO WXYZ ARRAY - IDENTIFYING EACH POINT WITH A PANEL.
C              MAX NUMBER OF XYZ'S, WORKSPACE-XYZ'S, KEYS, CONTROL
C              POINTS ALLOWED.
C              NUMBER OF LINKS, KEYS, XYZ'S, LINK-XYZ'S, WORKSPACE-
C              XYZ'S, CONTROLS, AND DIMENSIONS.
C              KEYTAB BOOKKEEPING ARRAY.
C              CONTROL POINT DATA.
C              STATE SWITCH ARRAY.
      INTEGER WXYZK,CTLTYP,CTLPNL,CTLPNT,BLANKS,CTLNAM
      COMMON /CBMXYZ/ XYZC(3,40,2),XYZ(3,40),WXYZ(3,750),WXYZK(750),
     1       MAXXYZ,MAXW,MAXKEY,MAXCTL,NLNKS,MSGXI(2),IRSRV(2),MSGX(2),
     2       ISRVY(2),MSGY(2),IWKSP(2),MSGZ(2),ITASK(2),
     3       KEYTAB(6,250),CTLNAM(2,150),
     4       CTLTYP(150),CTLXYZ(5,150),CTLPNL(150),CTLPNT(150),
     5       BLANKS(3),NKEY,NXYZ,NDIM,NLXYZ,NWXYZ,NCTL,IDSP,INPT,
     6       ISW(72)
C
      DIMENSION X(1),Y(1)
      INTEGER BLANK,HIER(20)
      EQUIVALENCE (BLANK,BLANKS(1))
C
      IF(ISW(13).EQ.1.AND.NKEY.GT.NLNKS) GO TO 55
C-----------------------------------------------------------------
C              PLOT MAN-MODEL LINKS AND CREW STATION
C-----------------------------------------------------------------
```

```
      J = IABS(KEYTAB(5,1))
      HIER(J) = 1
      CALL PLOT(X(1),Y(1),3)
      DO 50 I=2,NLNKS
       J = IABS(KEYTAB(5,I))
       K = KEYTAB(1,I)
       HIER(J) = 1
C-----------------------------------------------------------------------
C         DISPLAY ONLY HEAD AND NECK LINKS IF ISW(3)=0 (OFF)
C-----------------------------------------------------------------------
       IF((ISW(3).EQ.0.AND.(I.LE.5.OR.I.GE.11)).AND.ISW(5).EQ.0)
     *     GO TO 20
C-----------------------------------------------------------------------
C         LOCATE COORDINATE OF PREVIOUS POINT IN THE CHAIN
C-----------------------------------------------------------------------
       L = HIER(J-1)
       CALL PLOT(X(L),Y(L),3)
   10  M = 2
C-----------------------------------------------------------------------
C         CHECK IF THE LINE IS IN OMIT OR INCLUDE STATUS
C-----------------------------------------------------------------------
       IF (KEYTAB(5,I).LT.0.AND.KEYTAB(6,I).LT.0) M=3
       CALL PLOT(X(I),Y(I),M)
   20  J = IABS(KEYTAB(6,I))
       IF (J.EQ.1) GO TO 50
C-----------------------------------------------------------------------
C                         PLOT ENFLESHED MAN-MODEL
C-----------------------------------------------------------------------
   30  KP = KEYTAB(1,I)+NLNKS-1
       L1 = KP+KEYTAB(6,I)-2
C
   35  DO 45 L2=KP,L1
        CALL SYMBOL(X(L2)-.04,Y(L2),.175,1H.,0.0,1,.175,0)
   45  CONTINUE
C
       IF(MINTAN(1,I).EQ.0) GO TO 50
       L1 = MINTAN(1,I)+NLNKS
       L2 = MINTAN(2,I)+NLNKS
       CALL PLOT(X(L1),Y(L1),3)
       CALL PLOT(X(L2),Y(L2),2)
       L1 = MAXTAN(1,I)+NLNKS
       L2 = MAXTAN(2,I)+NLNKS
       CALL PLOT(X(L1),Y(L1),3)
       CALL PLOT(X(L2),Y(L2),2)
   50 CONTINUE
C-----------------------------------------------------------------------
C                       PLOT CREW STATION PANELS
C-----------------------------------------------------------------------
   55 CONTINUE
      IF (NLNKS.EQ.NKEY) RETURN
      II = NLNKS+1
C
      DO 80 I=II,NKEY
       K = KEYTAB(1,I)+NXYZ+NLNKS
       CALL PLOT(X(K),Y(K),3)
       M = 2
       IF (KEYTAB(5,I).LT.0.AND.KEYTAB(6,I).LT.0) M=3
       J = IABS(KEYTAB(6,I))
       L = K+1
       K = K+J-1
C
```

```
      DO 60 J=L,K
   60 CALL PLOT(X(J),Y(J),M)
C
   80 CONTINUE
C
      RETURN
      END
```

APPENDIX C-2

COMBIMAN SOURCE - CBMCP3 LISTING

```
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C
C     CBMCP3 - WRITES COMBIMAN DATA FOR OFF-LINE PLOT ON UNIT 11
C
C        CALLED BY -
C             CBMCP1 - MAIN COMBIMAN PLOT ROUTINE
C
C        OUTPUT TO -
C             UNIT 11
C
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C
      SUBROUTINE CBMCP3(DX,DY,SCLE,XZ01,XZ03,IEC,IPERSP)
C
      INTEGER IDX(2000)
      REAL DX(1),DY(1)
C
C
C        COMMON // CBMBXY //  MAN-MODEL XYZ DATA
C             PROJECTED ENFLESHMENT ELLIPSOID SURFACE POINTS - XYZ.
C             INDEX ARRAY TO DEFINE RELATIONSHIP BETWEEN POINTS AND
C             LINKS.
C             INDEX ARRAY TO XYZ'S TO LOCATE TANGENT LINE ENDPOINTS.
      INTEGER XYZK
      COMMON /CBMBXY/ XYZEN(3,1000),XYZK(1000),MINTAN(2,40),
     1        MAXTAN(2,40)
C
C        COMMON // CBMVEW //  MAN-MODEL AND WORKSPACE DISPLAY DATA
C             ROLL, PITCH, AND YAW DATA.
C             MAGNIFICATION LEVEL.
C             XYZ DISPLAY OFFSETS.
C             RANGE OF VALUES IN X,Y,Z DIRECTION.
C             MAXIMUM RANGE.
C             MINIMUM AND MAXIMUM X,Y,Z VALUES.
C             OMEGA TRANSFORMATION MATRIX.
      REAL MAGLVL
      COMMON /CBMVEW/ ROLL,PITCH,YAW,MAGLVL,DOFFX,DOFFY,DOFFZ,XD,YD,ZD,
     1        DD,XM,YM,ZM,XC,YC,ZC,MSGV(19),OMEGA(3,3),NOFF,
     2        IOMEGA,OFFSET(3)
C
C        COMMON // CBMXYZ //  MAN-MODEL AND WORKSPACE XYZ DATA
C             MAN-MODEL JOINT AND ELLIPSE CENTERS (NEUTRAL AND
C             PROJECTED).
C             WORKSPACE PANEL XYZ DATA.
C             KEY TO WXYZ ARRAY - IDENTIFYING EACH POINT WITH A PANEL.
C             MAX NUMBER OF XYZ'S, WORKSPACE-XYZ'S, KEYS, CONTROL
C             POINTS ALLOWED.
C             NUMBER OF LINKS, KEYS, XYZ'S, LINK-XYZ'S, WORKSPACE-
C             XYZ'S, CONTROLS, AND DIMENSIONS.
C             KEYTAB BOOKKEEPING ARRAY.
C             CONTROL POINT DATA.
C             STATE SWITCH ARRAY.
      INTEGER WXYZK,CTLTYP,CTLPNL,CTLPNT,BLANKS,CTLNAM
      COMMON /CBMXYZ/ XYZC(3,40,2),XYZ(3,40),WXYZ(3,750),WXYZK(750),
     1        MAXXYZ,MAXW,MAXKEY,MAXCTL,NLNKS,MSGX1(2),IRSRV(2),MSGX(2),
     2        ISRVY(2),MSGY(2),IWKSP(2),MSGZ(2),ITASK(2),
     3        KEYTAB(6,250),CTLNAM(2,150),
     4        CTLTYP(150),CTLXYZ(5,150),CTLPNL(150),CTLPNT(150),
     5        BLANKS(3),NKEY,NXYZ,NDIM,NLXYZ,NWXYZ,NCTL,IDSP,INPT,
     6        ISW(72)
C
```

```
      INTEGER PVIEW
C
      IEC = 0
      PVIEW = OMEGA(1,2)+OMEGA(2,3)+2
      TEMP = ABS(ROLL)+ABS(PITCH)+ABS(YAW)
      IF(TEMP.NE.0.) PVIEW=4
      N = ISW(25)
C                                PLOT NUMBER
      MAXD = NXYZ+NWXYZ+NLNKS
      WRITE(11,1000) MAXD,NWXYZ,NKEY,NLNKS,NXYZ,SCLE,XZD1,XZD3,N,IPERSP
C
      DO 20 I=1,MAXD
       IDX(I) = DX(I)*100.
   20 CONTINUE
      WRITE(11,1001) (IDX(I),I=1,MAXD)
C
      DO 25 I=1,MAXD
       IDX(I) = DY(I)*100.
   25 CONTINUE
      WRITE(11,1001) (IDX(I),I=1,MAXD)
      WRITE(11,1001) (KEYTAB(1,I),I=1,NKEY)
      WRITE(11,1001) (KEYTAB(5,I),I=1,NKEY)
      WRITE(11,1001) (KEYTAB(6,I),I=1,NKEY)
C
      DO 50 I=1,2
       WRITE(11,1002) (MINTAN(I,J),J=1,NLNKS)
       WRITE(11,1002) (MAXTAN(I,J),J=1,NLNKS)
   50 CONTINUE
C
      WRITE(11,1003) IWSRV,ISRVY,IWKSP
      WRITE(11,1004) PVIEW,ROLL,PITCH,YAW
      WRITE(11,1005)
      RETURN
C------------------------------------------------------------
C                      FORMAT STATEMENTS
C------------------------------------------------------------
 1000 FORMAT(I4,2I3,I2,I4,F4.2,2F7.2,2I2)
 1001 FORMAT(16I5)
 1002 FORMAT(20I4)
 1003 FORMAT(20A4)
 1004 FORMAT(I2,3F10.2)
 1005 FORMAT (4H-999)
      END
```

APPENDIX C-3

COMBIMAN SOURCE - CBMCP4 LISTING

```
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C
C     CBMCP4 - FLCTS HEADINGS AND DEFINES BOUNDARIES FOR
C              PLOTS OF MAN MODEL AND CREW STATION ON
C              GOULD PLOTTER (INTERMEDIATE ROUTINE)
C
C        CALLED BY -
C             CBMCP1 - MAIN COMBIMAN PLOT ROUTINE
C
C        CALLS -
C             CBMCP2 - PLOTS MAN-MODEL AND CREW STATION ON GOULD
C             CLSOUT - FREE BUFFER (GOULD)
C             NUMBER - PLOT NUMBER (GOULD)
C             PLOT   - GENERAL PLOT (GOULD)
C             PLOTS  - INITIALIZE PLOTTER (GOULD)
C             SYMBOL - PLOT SYMBOL (GOULD)
C
C        OUTPUT TO -
C             SYSPLOT - GOULD PLOTTER
C
C        PARAMETERS -
C             OX(3000) ARRAY OF SCALED X COORDINATES
C             OY(3000) ARRAY OF SCALED Y COORDINATES
C             SCLE - PLOT SCALE FACTOR
C             IX - REAL WORLD COORD. ALIGNED WITH X SCREEN COORD.
C             IY - REAL WORLD COORD. ALIGNED WITH Y SCREEN COORD.
C
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C
      SUBROUTINE CBMCP4(OX,OY,SCLE,IPERSP)
C
      DIMENSION XZD(3),OX(1),OY(1)
      INTEGER MSG(3),IVIEW(5),MSG1(5),BLANK
C
C        COMMON // CBMBXY //  MAN-MODEL XYZ DATA
C             PROJECTED ENFLESHMENT ELLIPSOID SURFACE POINTS - XYZ.
C             INDEX ARRAY TO DEFINE RELATIONSHIP BETWEEN POINTS AND
C             LINKS.
C             INDEX ARRAY TO XYZ'S TO LOCATE TANGENT LINE ENDPOINTS.
      INTEGER XYZK
      COMMON /CBMBXY/ XYZEN(3,1000),XYZK(1000),MINTAN(2,40),
     1        MAXTAN(2,40)
C
C        COMMON // CBMVEW //  MAN-MODEL AND WORKSPACE DISPLAY DATA
C             ROLL, PITCH, AND YAW DATA.
C             MAGNIFICATION LEVEL.
C             XYZ DISPLAY OFFSETS.
C             RANGE OF VALUES IN X,Y,Z DIRECTION.
C             MAXIMUM RANGE.
C             MINIMUM AND MAXIMUM X,Y,Z VALUES.
C             OMEGA TRANSFORMATION MATRIX.
      REAL MAGLVL
      COMMON /CBMVEW/ ROLL,PITCH,YAW,MAGLVL,OOFFX,OOFFY,OOFFZ,XD,YD,ZD,
     1        DD,XM,YM,ZM,XC,YC,ZC,MSGV(19),OMEGA(3,3),NOFF,
     2        IOMEGA,OFFSET(3)
C
C        COMMON // CBMXYZ //  MAN-MODEL AND WORKSPACE XYZ DATA
C             MAN-MODEL JOINT AND ELLIPSE CENTERS (NEUTRAL AND
C             PROJECTED).
C             WORKSPACE PANEL XYZ DATA.
C             KEY TO WXYZ ARRAY - IDENTIFYING EACH POINT WITH A PANEL.
```

```
C             MAX NUMBER OF XYZ'S, WORKSPACE-XYZ'S, KEYS, CONTROL
C             POINTS ALLOWED.
C             NUMBER OF LINKS, KEYS, XYZ'S, LINK-XYZ'S, WORKSPACE-
C             XYZ'S, CONTROLS, AND DIMENSIONS.
C             KEYTAB BOOKKEEPING ARRAY.
C             CONTROL POINT DATA.
C             STATE SWITCH ARRAY.
      INTEGER WXYZK,CTLTYP,CTLPNL,CTLPNT,BLANKS,CTLNAM
      COMMON /CEMXYZ/ XYZC(3,40,2),XYZ(3,40),WXYZ(3,750),WXYZK(750),
     1       MAXXYZ,MAXW,MAXKEY,MAXCTL,NLNKS,MSGX1(2),IRSRV(2),MSGX(2),
     2       ISRVY(2),MSGY(2),IWKSP(2),MSGZ(2),ITASK(2),
     3       KEYTAB(6,250),CTLNAM(2,150),
     4       CTLTYP(150),CTLXYZ(5,150),CTLPNL(150),CTLPNT(150),
     5       BLANKS(3),NKEY,NXYZ,NDIM,NLXYZ,NWXYZ,NCTL,IDSP,INPT,
     6       ISW(72)
C
      EQUIVALENCE (XZD(1),XD)
      EQUIVALENCE (BLANK,BLANKS(1))
C
      DATA IVIEW/'XY  ','XZ  ','YZ  ','OFF ','AXIS'/
      DATA MSG/4HVIEW,4H-PLA,4HNE: /
      DATA MSG1/4HROLL,4H   P,4HITCH,4H    ,4HYAW /
      NCH = 4
C                           NUMBER OF CHARACTERS TO BE DISPLAYED
      PVIEW = OMEGA(1,2)+OMEGA(2,3)+2
      TEMP = ABS(ROLL) + ABS(PITCH) + ABS(YAW)
      IF(TEMP.NE.0) PVIEW=4
      IF(PVIEW.EQ.4) NCH=8
C------------------------------------------------------------------
C                    PLOT TITLE
C------------------------------------------------------------------
      CALL PLOTS(5.,10.)
C                           SIZE OF PLOT
      CALL SYMBOL(1.,1.75,.25,MSGX1(1),90.,16,.25,0)
C                           REGRESSION MEMBER
      CALL SYMBOL(1.5,1.75,.25,MSGX(1),90.,16,.25,0)
C                           SURVEY MEMBER
      CALL SYMBOL(2.0,2.,.25,MSGY(1),90.,16,.25,0)
C                           CREW STATION MEMBER
      CALL SYMBOL(2.5,1.,.25,MSG(1),90.,12,.25,0)
C                           VIEW PLANE:
      CALL SYMBOL(999.,999.,.25,IVIEW(PVIEW),90.,NCH,.25,0)
C                           VIEW XY, XZ, YZ OR OFF AXIS
      CALL SYMBOL(3.0,1.5,.25,MSG1(1),90.,20,.25,0)
C                           ROLL, PITCH, AND YAW
      CALL NUMBER(3.5,2.25,.25,ROLL,90.,1,2)
C                           ROLL ANGLE IN DEGREES
      CALL NUMBER(3.5,4.25,.25,PITCH,90.,1,2)
C                           PITCH ANGLE IN DEGREES
      CALL NUMBER(3.5,6.5,.25,YAW,90.,1,2)
C                           YAW ANGLE IN DEGREES
      IF (IPERSP.EQ.1) CALL SYMBOL(4.,1.75,.25,15HNON-PERSPECTIVE,
     *         90.,15)
      IF (IPERSP.EQ.2) CALL SYMBOL(4.,2.25,.25,11HPERSPECTIVE,
     *         90.,11)
      CALL SYMBOL(4.5,2.25,.25,6HSCALE=,90.,6)
      CALL NUMBER(999.,999.,.25,SCLE,90.,2)
C                           SCALE
      CALL PLOT(0.,0.,999)
C                           TERMINATE TITLE PLOT
      CALL PLOTS(-60.,-60.)
```

```
C                                START COMBIMAN PLOT
      CALL CBMCF2(DX(1),DY(1))
C                                PLOT MAN-MODEL AND CREW STATION
      CALL PLOT(0.,0.,999)
C                                TERMINATE COMBIMAN PLOT
      CALL CLSOUT
C                                CLOSE FILE AND FREE CORE
      RETURN
      END
```

APPENDIX C-4

COMBIMAN SOURCE - CBMVSI LISTING

```
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *C
C                                                                C
C     CBMVS1 -- GENERATES VISIBILITY PLOTS ON GOULD PLOTTER      C
C                                                                C
C        CALLED BY -                                             C
C             CBMVIS - COMBIMAN VISIBILITY ROUTINE               C
C                                                                C
C        CALLS -                                                 C
C             ABS    - ABSOLUTE VALUE OF REAL VARIABLE           C
C             CLSCUT - CLOSE GOULD PLOTTER                       C
C             IABS   - ABSOLUTE VALUE OF INTEGER VARIABLE        C
C             IFIX   - CONVERT REAL VARIABLE TO INTEGER          C
C             IMIN   - MINIMUM VALUE AMONG INTEGERS              C
C             NUMBER - GOULD NUMBER PLOT ROUTINE                 C
C             PLOT   - GOULD LINE, POINT PLOT ROUTINE            C
C             PLOTS  - GOULD INITIALIZATION ROUTINE              C
C             SIGN   - SIGN OF REAL VARIABLE                     C
C             SQRT   - SQUARE ROOT OF VARIABLE                   C
C             SYMBOL - GOULD CHARACTER PLOT ROUTINE              C
C                                                                C
C        OUTPUT TO -                                             C
C             GOULD  - PLOTTER                                   C
C                                                                C
C        PARAMETER -                                             C
C             IPLOT = 1 -- INITIALIZE GOULD PLOTTER              C
C                   = 9999 -- TERMINATE PLOTTER                  C
C                   = ANY OTHER VALUE -- PLOT POINTS             C
C                                                                C
C        REMARKS -                                               C
C             IN ORDER TO GENERATE VISIBILITY PLOT USING         C
C             AN ON-LINE PLOTTER ALL GOULD PLOTTER ROUTINES      C
C             SHOULD BE CHANGED.                                 C
C                                                                C
C * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *C
C
      SUBROUTINE CBMVS1(IPLOT)
C
COPY,S CBMPOT
C        COMMON  // CBMPOT //  OUTPUT HEADING DATA
C             PAGE, LINE NUMBER, DATE AND TIME DATA.
C
      COMMON /CBMPOT/ IPAGE,LINE,IMONTH,IDAY,IYEAR,IHOUR,IMIN,ISEC
C
COPY,S CBMVSB
C        COMMON  // CBMVSB //  HORIZONTAL AND VERTICAL VISION
C             ANGLES, NAME OF MEMBER, HORIZONTAL AND VERTICAL
C             ANGLES OF CREWMEMBERS HEAD, THEIR SIGN SWITCHES,
C             NUMBER OF POINTS, AND EYE COORDINATES
C
      COMMON /CBMVSB/ ALPH(2500),BETA(2500),INAME(2),HANG,
     1          IHA,IHS,IVA,IVS,VANG,NPNTS,XLEYE,YLEYE,ZLEYE
C
C
      DIMENSION IHT(3,3),IVT(2,3),IHL(3),IVL(3),AB(3,4),IELIPS(4)
C
      DATA IHT/4HRIGH,4HT OF,4H    ,4HFROM,4H    ,4H    ,
     1        4HLEFT,4H OF ,4H    /,
     2     IVT/4HBELO,4HW   ,4HFROM,4H    ,4HABOV,4HE   /,
     3     IELIPS/1HM,1HP,1HF,1HS/, IHL/9,5,6/, IVL/6,5,6/,
     4     AB/165.,66.,-82.,95.,66.,-82.,74.,48.,-66.,56.,48.,-66./
C
```

```
      IF (IPLOT.EQ.9999) GO TO 300
C                                    CLOSE PLOTTER AND TERMINATE PLOTTING
      IF (IPLOT.NE.1) GO TO 200
C                                    PLOT POINTS ALONG CONTOUR
C------------------------------------------------------------------C
C             DEFINE SIZE OF PLOT TO BE 19X10
C------------------------------------------------------------------C
      CALL PLOTS(19.,10.)
C------------------------------------------------------------------C
C                        DRAW LEFT MARGIN
C------------------------------------------------------------------C
      CALL PLOT(.05,0.,3)
      CALL PLOT(.05,10.,2,3)
      CALL PLOT(1.,0.,-3)
C------------------------------------------------------------------C
C             PRINT HORIZONTAL & VERTICAL HEADINGS
C------------------------------------------------------------------C
      CALL SYMBOL(.2,2.6,.3,16HVERTICAL DEGREES,90.,16)
      CALL SYMBOL(.5,3.3,.2,16HFROM LINE-OF-SIGHT,90.,18)
      CALL SYMBOL(3.25,.5,.3,37HHORIZONTAL DEGREES FROM LINE-OF-SIGHT,
     1             0.,37)
C------------------------------------------------------------------C
C                        OUTLINE AREA OF PLOT
C------------------------------------------------------------------C
      CALL PLOT(1.2,1.5,3)
      CALL PLOT(1.2,8.8,2,-1)
      CALL PLOT(15.6,8.8,2,-1)
      CALL PLOT(15.6,1.6,2,-1)
      CALL PLOT(1.1,1.6,2,-1)
C------------------------------------------------------------------C
C                        DRAW VERTICAL GRID
C------------------------------------------------------------------C
      XC = 15.6
      A = 1.1
      YC = 1.6
      DO 100 I=1,17 ,2
       YC = YC+.4
       CALL PLOT(A,YC,3)
       CALL PLOT(XC,YC,2,1)
       IF (I.EQ.17) GO TO 100
       IF (I.EQ.15) XC=13.6
       IF (I.EQ.15) A=3.2
       YC = YC+.4
       CALL PLOT(XC,YC,3)
       CALL PLOT(A,YC,2)
  100 CONTINUE
C------------------------------------------------------------------C
C                        DRAW HORIZONTAL GRID
C------------------------------------------------------------------C
      XC = 1.2
      YC = 7.6
      DO 110 I=1,35,2
       XC = XC+.4
       IF (I.EQ.5) YC=8.8
       CALL PLOT(XC,1.5,3)
       CALL PLOT(XC,YC,2,1)
       IF (I.EQ.35) GO TO 110
       XC = XC+.4
       IF (I.EQ.31) YC=7.6
       CALL PLOT(XC,YC,3)
       CALL PLOT(XC,1.5,2)
```

```
  110  CONTINUE
C------------------------------------------------------------------C
C                   PUT LEGENDS ON THE PLOT
C------------------------------------------------------------------C
       A = .075
       A1 = 13.8
       CALL SYMBOL(13.75,8.6,.1,13HVISION LIMITS,0.,13)
       CALL SYMBOL(A1,8.29,A,23HS - STEREO              ,0.,23)
       CALL SYMBOL(A1,8.11,A,23HF - FIXATION            ,0.,23)
       CALL SYMBOL(A1,7.93,A,23HP - PERIPHERAL          ,0.,23)
       CALL SYMBOL(A1,7.75,A,23HM - MAXIMUM PERIPHERAL  ,0.,23)
       CALL SYMBOL(1.5,8.6,.1,12HEYE LOCATION,0.,12)
       CALL SYMBOL(1.75,8.45,.075,4HX = ,0.,4)
       CALL NUMBER(2.05,8.45,.075,XLEYE,0.,2)
       CALL SYMBOL(1.75,8.30,.075,4HY = ,0.,4)
       CALL NUMBER(2.05,8.30,.075,YLEYE,0.,2)
       CALL SYMBOL(1.75,8.15,.075,4HZ = ,0.,4)
       CALL NUMBER(2.05,8.15,.075,ZLEYE,0.,2)
       CALL SYMBOL(1.3,7.95,.085,13HCREW STATION:,0.,13)
       CALL SYMBOL(2.405,7.95,.085,INAME(1),0.,4)
       CALL SYMBOL(2.745,7.95,.085,INAME(2),0.,4)
       CALL SYMBOL(1.675,7.75,.075,5HDATE:,0.,5)
       CALL NUMBER(999.,999.,.075,IMONTH,0.,-1)
       CALL SYMBOL(999.,999.,.075,1H/,0.,1)
       CALL NUMBER(999.,999.,.075,IDAY  ,0.,-1)
       CALL SYMBOL(999.,999.,.075,1H/,0.,1)
       CALL NUMBER(999.,999.,.075,IYEAR ,0.,-1)
C
C------------------------------------------------------------------C
C                        LABEL VERTICAL AXIS
C------------------------------------------------------------------C
       YC = 1.5
       IY = 90
       DO 130 I=1,7
        XC = .65
        IYP = IABS(IY)
        IF (IYP.LT.10) XC=XC+.15
        CALL NUMBER(XC,YC,.15,IYP,0.,-1)
        CALL SYMBOL(999.,999.,.15,46,0.,-1)
        CALL SYMBOL(999.,999.,0.,1H0,0.,1)
        YC = YC+1.2
        IF (YC.GT.8.7) GO TO 140
        IY = IY-30
  130  CONTINUE
C------------------------------------------------------------------C
C                        LABEL HORIZONTAL AXIS
C------------------------------------------------------------------C
  140  CONTINUE
       XC = 1.3
       J = 210
       DO 150 I=1,13
        YC = .9
        J = J-30
        L = IABS(J)
        IF (L.LT.100) YC=YC+.15
        IF (L.LT.10) YC=YC+.15
        CALL NUMBER(XC,YC,.15,L,90.,-1)
        CALL SYMBOL(999.,999.,.15,46,90.,-1)
        CALL SYMBOL(999.,999.,0.,1H0,90.,1)
        XC = XC+1.2
  150  CONTINUE
```

```
C------------------------------------------------------------------C
C           PRINT ORIENTATION OF THE CREWMWMBER'S HEAD
C------------------------------------------------------------------C
      IHA = HANG+SIGN(.5,HANG)
C                                   HORIZONTAL ANGLE
      IHS = 1
C                                   SWITCH TO INDICATE SIGN OF IHA
C                                   1 FOR NEGATIVE, 2 FOR ZERO, AND
C                                   3 FOR POSITIVE
      IF (IHA .GT. 0.0) IHS=3
      IF (IHA .EQ. 0.0) IHS=2
      IF (IHA .LT. 0.0) IHA=-IHA
      IVA = VANG+SIGN(.5,VANG)
C                                   VERTICAL ANGLE
      IVS = 1
C                                   SWITCH TO INDICATE SIGN OF IVA
      IF (IVA .GT. 0.0) IVS=3
      IF (IVA .EQ. 0.0) IVS=2
      IF (IVA .LT. 0.0) IVA=-IVA
C                                   RESET VERTICAL ANGLE
      ITL = 58+IHL(IHS)+IVL(IVS)
      IF (IHA.LT.10) ITL=ITL-1
      IF (IVA.LT.10) ITL=ITL-1
      TSP = (15.-(ITL*.2))/2.+.8
C
      CALL SYMBOL(TSP,9.,.2,30HCREWMEMBERS HEAD IS POINTING   ,0.,30)
      CALL NUMBER(999.,999.,.2,IHA,0.,-1)
      CALL SYMBOL(999.,9.12,.12,2HO ,0.,2)
      CALL SYMBOL(999.,9.,.2,IHT(1,IHS),0.,IHL(IHS))
      CALL SYMBOL(999.,999.,.2,12HFORWARD AND  ,0.,12)
      CALL NUMBER (999.,999.,.2,IVA,0.,-1)
      CALL SYMBOL(999.,9.12,.12,2HO ,0.,2)
      CALL SYMBOL(999.,9.,.2,IVT(1,IVS),0.,IVL(IVS))
      CALL SYMBOL(999.,999.,.2,10HHORIZONTAL ,0.,10)
      CALL PLOT(1.2,1.6,-3)
      CALL SYMBOL(7.2,3.6,.15,1,0.,-1)
C------------------------------------------------------------------C
C               GENERATE VISION LIMIT ELLIPSES
C                SSS... FOR STEREO,
C                FFF... FOR FIXATION,
C                PPP... FOR PERIFERAL, AND
C                MMM... FOR MAXIMUM PERIFERAL VISIONS
C------------------------------------------------------------------C
      DO 170 I=1,4
       A = AB(1,I)
       X1 = -A
       LIM = IFIX(A)+1
C
       DO 160 J=1,LIM
        SQ1 = SQRT(1.-(X1/A)**2)
        A1 = AB(2,I)*SQ1
        A2 = AB(3,I)*SQ1
        X11 = (X1+180.)*.04
        Y11 = (A1+90.)*.04
        Y21 = (A2+90.)*.04
        CALL SYMBOL(X11,Y11,.0875,IELIPS(I),0.,1,.1,1)
        CALL SYMBOL(X11,Y21,.0875,IELIPS(I),0.,1,.1,1)
        X1 = X1+2.
  160  CONTINUE
C
  170 CONTINUE
```

```
C-----------------------------------------------------------------C
C                PLOT POINTS ALONG CONTOUR
C        THE POINTS ARE PLOTTED IN THE REGION DEFINED BY X---X
C
C                                                 (12.3,7.125)
C          -------X-----------------------------------X------
C          I      I                                   I     I
C          I      I                 B                 I     I
C          X------X              I  B   I             X-----X
C          I    (2,5.925)   S    I      I   L               I
C          I           I    S               L   I           I
C          I      V    I          P L O T       I   T   Y   I
C          I      V               P L O T           T   Y   I
C          I                                                I
C          X------------------------------------------------X
C        (0,0)                                        (0,14.3)
C-----------------------------------------------------------------C
  200 CONTINUE
      IPEN = 3
      DO 230 I=1,NPNTS
       XC = ALPH(I)*.04
       YC = BETA(I)*.04
       IF (I.EQ.1) GO TO 210
       A = ABS(ALPH(I)-ALPH(I-1))
       A1 = (ALPH(I)+ALPH(I-1))/2
       A2 = (BETA(I)+BETA(I-1))/2
       IF (A.GE.35.) IPEN=3
       IF (A1.LT.1. .OR. A1.GT.359. .OR.
     *       A2.LT.1. .OR. A2.GT. 179.) IPEN=3
C                               SEGMENTS DISTORTED BEYOND REASON
C                               ARE NOT PLOTTED
  210  CONTINUE
       IBNDRY = 0
C                               SET BOUNDARY SWITCH TO 0
       IF (XC.LT.0..OR.XC.GT.14.3.OR.YC.LT.0..OR.YC.GT.7.125)
     *     IBNDRY=1
       IF ((XC.LT.2.0.OR.XC.GT.12.3).AND.YC.GT.5.925)
     *     IBNDRY=1
       IF (IBNDRY.EQ.0) CALL PLOT(XC,YC,IPEN)
C                               PLOT POINTS WITHIN BOUNDARY ONLY
       IPEN = 2
       IF (IBNDRY.EQ.1) IPEN=3
  230 CONTINUE
      RETURN
C-----------------------------------------------------------------C
C                   END PLOTTER ROUTINES
C-----------------------------------------------------------------C
  300 CONTINUE
      CALL PLOT(0.,0.,999)
      CALL CLSOUT
      RETURN
      END
```

APPENDIX C-5

COMBIMAN SOURCE - CBMOFF LISTING

```
C
C   CBMOFF- TAKES DATA OFF OF TAPE TO BE USED TO PLOT COMBIMAN--OFFLINE
C
C
C        CALLS -
C              PLOTS  - CALCOMP ROUTINE (PLOT INITIALIZATION)
C              PLOT   - CALCOMP ROUTINE (DRAW LINE OR POSITION THE PEN)
C              NEWPEN - CALCOMP ROUTINE (CHANGE THE PEN COLOR)
C              FACTR  - CALCOMP ROUTINE (RESET PLOT SCALE FACTOR)
C              SYMBOL - CALCOMP ROUTINE (DRAW A SYMBOL, CHARACTER, OR A
C                          CHARACTER STRING)
C              NUMBER - CALCOMP ROUTINE (DRAW A NUMBER)
C              CBMCPD - PLOT THE MAN MODEL AND CREW STATION
C              PLOTE  - CALCOMP ROUTINE (CLOSE THE PLOT FILE)
C
C        INPUT FROM -
C              UNIT 5 - CARD INPUT
C              UNIT 8 - PLOT DATA ON DISK OR MAGNETIC TAPE OR CARDS
C
C        OUTPUT TO -
C              UNIT 6 - PRINTER
C              UNIT 7 - PLOT TAPE
C
C
      REAL DX(2000),DY(2000)
      COMMON/DUMMY/ MSGX1(2),IRSRV(2),MSGX(2),ISRVY(2),MSGY(2),IWKSP(2)
      DIMENSION IPLOT(20),DATA(1024)
      COMMON/CBMXYZ/ KEYTAB(3,250),NLNKS,MINTAN(2,40),MAXTAN(2,40),
     1     NKEY,NXYZ,ICOLOR(4),FLESH,FACTR,SCLE
C
C***  THE INPUT STREAM CONSISTS OF
C          1. THE NAMELIST "CNTRL", EVEN IF IT'S EMPTY
C          2. A CARD WITH THE NUMBERS OF THE PLOTS NOT WANTED
C
C          ALSO;THE PLOT DATA FILE SHOULD BE ATTACHED TO THE PROGRAM AS
C             UNIT 8.
C
C  THE NAMELIST VARIABLES AND THEIR DEFAULT VALUES
C  1...FACTR- SCALE FACTOR FOR PLOT (DEFAULT=THAT SPECIFIED DURING
C             CBM05 RUN)
C   2...LINKS- 0, IF LINK SYSTEM IS TO BE PLOTTED; 1, IF NOT (DEF=0)
C    3...FLESH- 0, IF ENFLESHMENT ELIPSOIDS ARE TO BE PLOTTED: 1, IF
C          NOT (DEF=0)
C     4...CRST- 0, IF CREW STATION IS TO BE PLOTTED; 1, IF NOT (DEF=0)
C      5...(ICOLOR(I), I=1,4)- PEN COLORS FOR BANNER, LINK SYSTEM,
C          ENFLESHMENT ELIPSOIDS, AND CREW STATION RESPECTIVELY
C          (DEF=1, 1, 2, 3)
C
      DIMENSION MSG1(3),MSG2(3),MSG3(3),MSG4(3),MSG5(6),IVIEW(5)
      INTEGER FLESH,CRST,PVIEW
      NAMELIST /CNTRL/ FACTR,LINKS,FLESH,CRST,ICOLOR
      DATA FACTR,LINKS,FLESH,CRST/99.,3*0/
      DATA  END/4H-999/,IPCNT/0/
      DATA MSG1/4H     ,4HREGR,4HESS!/, MSG2/4H     ,4H SUR,4HVEY!/,
     1     MSG3/4H     ,4H   C,4HRST!/, MSG4/4H VIE,4HW-PL,4HANE!/,
     2     MSG5/3H  R,4HOLL ,4H  PI,4HTCH ,4H   Y,4HAW  /
      DATA IVIEW/4HXY  ,4HXZ  ,4HYZ  ,4HOFF ,4HAXIS/
```

```
      ICOLOR(1)=1
      ICOLOR(2)=1
      ICOLOR(3)=2
      ICOLOR(4)=3
      READ(5,CNTRL)
      WRITE(6,CNTRL)
C
C   READ IN PLOT NUMBERS FOR THOSE NOT WANTED(IN ANY ORDER)
      READ(5,80) (IPLOT(I),I=1,20)
   80 FORMAT(20(1X,I2))
C
C
C   PLOT INITIALIZATION FOR OFFLINE CALCOMP PLOT
      CALL PLOTS(DATA,1024,7)
C
C
C   MOVE THE PEN TO THE -Y LIMIT SWITCH(PEN PLOTTER ONLY)
      CALL PLOT(0.,-2.,-3)
C
C
C   SET THE MARGIN
      CALL PLOT(1.,1.,-3)
C
      IPC=0
C
C***  ROUTINE TO CHECK IF PLOT IS WANTED
C
    5 IPCNT=IPCNT+1
      DO 145 ICHECK=1,20
      IF(IPCNT .NE. IPLOT(ICHECK)) GO TO 145
C     SKIP PLOT DATA SUBFILE
  140 READ(8,90) DATA01
      IF(EOF(8))130,141
  141 IF(DATA01 .NE. END) GO TO 140
      WRITE(6,150) IPCNT
  150 FORMAT(1X,9HPLOT SET ,I2,28H WAS NOT PLOTTED--BY REQUEST)
      GO TO 5
  145 CONTINUE
      IPC=IPC+1
C
C***  ROUTINE FOR READING DATA OFF TAPE
C
      READ(8,10)MAXD,NHXYZ,NKEY,NLNKS,NXYZ,SCLE,XO,YO,N,IPERSP
      IF(EOF(8))130,12
   10 FORMAT(I4,2I3,I2,I4,F4.2,2F7.2,2I2)
   12 READ(8,30) (DX(I),I=1,MAXD)
      READ(8,30) (DY(I),I=1,MAXD)
   30 FORMAT(16F5.2)
      READ(8,35) (KEYTAB(1,I),I=1,NKEY)
      READ(8,35) (KEYTAB(2,I),I=1,NKEY)
      READ(8,35) (KEYTAB(3,I),I=1,NKEY)
   35 FORMAT(16I5)
      DO 53 I=1,2
      READ(8,40)  (MINTAN(I,J),J=1,NLNKS)
      READ(8,40)  (MAXTAN(I,J),J=1,NLNKS)
```

```
   40 FORMAT(20I4)
   50 CONTINUE
      READ(8,60) IRSRV(1),IRSRV(2),ISRVY(1),ISRVY(2),IWKSP(1),IWKSP(2)
   60 FORMAT(20A4)
      READ(8,65) PVIEW,ROLL,PITCH,YAW
   65 FORMAT(I2,3F10.2)
      READ(8,90) ENDFLE
   90 FORMAT(A4)
      IF(ENDFLE .EQ.   END) GO TO 151
      WRITE(6,110)     N
  110 FORMAT(1X,33HINCORRECT AMOUNT OF DATA FOR PLOT,I2,
     -17H --PROGRAM ENDING)
      STOP
C
C***  PLOTTING ROUTINE
C
  151 CONTINUE
C
C   SPECIFY COLOR FOR THE BANNER
      CALL NEWPEN(ICOLOR(1))
C
C   PLOT THE BANNER
C
C                                    REGRESSION MEMBER
      CALL SYMBOL(1.,1.25,.35,MSG1(1),90.,4)
      CALL SYMBOL(999.,999.,.35,MSG1(2),90.,4)
      CALL SYMBOL(999.,999.,.35,MSG1(3),90.,4)
      CALL SYMBOL(999.,999.,.35,IRSRV(1),90.,4)
      CALL SYMBOL(999.,999.,.35,IRSRV(2),90.,4)
C
C                                    SURVEY MEMBER
      CALL SYMBOL (1.5,1.25,.35,MSG2(1),90.,4)
      CALL SYMBOL (999.,999.,.35,MSG2(2),90.,4)
      CALL SYMBOL(999.,999.,.35,MSG2(3),90.,4)
      CALL SYMBOL (999.,999.,.35,ISRVY(1),90.,4)
      CALL SYMBOL (999.,999.,.35,ISRVY(2),90.,4)
C
C                                    CREW STATION MEMBER
      CALL SYMBOL (2.,1.25,.35,MSG3(1),90.,4)
      CALL SYMBOL (999.,999.,.35,MSG3(2),90.,4)
      CALL SYMBOL (999.,999.,.35,MSG3(3),90.,4)
      CALL SYMBOL (999.,999.,.35,IWKSP(1),90.,4)
      CALL SYMBOL (999.,999.,.35,IWKSP(2),90.,4)
C
C                                    VIEW PLANE:
      CALL SYMBOL(2.5,1.25,.35,MSG4(1),90.,4)
      CALL SYMBOL (999.,999.,.35,MSG4(2),90.,4)
      CALL SYMBOL (999.,999.,.35,MSG4(3),90.,4)
C
C                                    VIEW XY, XZ, YZ, OR OFF AXIS
      CALL SYMBOL(999.,999.,.35,IVIEW(PVIEW),90.,4)
      IF(PVIEW.EQ.4)CALL SYMBOL(999.,999.,.35,IVIEW(5),90.,4)
C
```

```
C                                 ROLL, PITCH, AND YAW
      CALL SYMBOL(3.0,1.25,.35,MSG5(1),90.,3)
      DO 155 I=2,6
  155 CALL SYMBOL(999.,999.,.35,MSG5(I),90.,4)
C
C                                 ROLL ANGLE IN DEGREES
      YINC=0.
      IF(ABS(ROLL).GE.10.)  YINC=.175
      IF(ABS(ROLL).GE.100.)YINC=.35
      IF(ROLL.LT.0.)YINC=YINC+.175
      CALL NUMBER(3.5,2.12-YINC,.35,ROLL,90.,1)
C
C                                 PITCH ANGLE IN DEGREES
      YINC=0.
      IF(ABS(PITCH).GE.10.)  YINC=.175
      IF(ABS(PITCH).GE.100.)YINC=.35
      IF(PITCH.LT.0.)YINC=YINC+.175
      CALL NUMBER(3.5,4.75-YINC,.35,PITCH,90.,1)
C
C                                 YAW ANGLE IN DEGREES
      YINC=0.
      IF(ABS(YAW).GE.10.) YINC=.175
      IF(ABS(YAW).GE.100.)YINC=.35
      IF(YAW.LT.0.)YINC=YINC-.175
      CALL NUMBER(3.5,7.55-YINC,.35,YAW,90.,1)
C
C                                 PERSPECTIVE OR NON-PERSPECTIVE
      IF(IPERSP.EQ.1)CALL SYMBOL(4.,2.65,.35,15HNON-PERSPECTIVE,90.,15)
      IF(IPERSP.EQ.2)CALL SYMBOL(4.,3.35,.35,11HPERSPECTIVE,90.,11)
C
C                                 SCALE
      IF(FACTR.NE.99.)  SCLE=FACTR
      CALL SYMBOL(4.5,3.35,.35,6HSCALE=,90.,6)
      CALL NUMBER(999.,999.,.35,SCLE,90.,2)
C
C                                 PLOT NUMBER
      PLT=N
      CALL SYMBOL(5.0,3.7,.35,5HPLOT=,90.,5)
      CALL NUMBER(999.,999.,.35,PLT,90.,-1)
C
C
C   RESET ORIGIN
      CALL PLOT(7.,0.,-3)
C
C
C   GO TO MAN-MODEL AND CREW STATION PLOT ROUTINE
      CALL CBMCP2(OX(1),OY(1))
C
      CALL FACTOR(1.0)
      CALL PLOT(12.,0.,-3)
      GO TO 5
C
C   PLOTE CLOSES OUT THE PLOT
  130 CALL PLOTE(AA)
C
      STOP
      END
```

```
C
C     CBMCP2 - CALCOMP PLOT OF COMBIMAN SECOND SUBROUTINE--ADJUSTED
C              FOR PLOTTING OFFLINE.
C
C        CALLED BY -
C              CBMOFF - CALCOMP (R) PLOT OF COMBIMAN MAIN S/R
C
C        CALLS -
C              PLOT   - CALCOMP ROUTINE (DRAW LINE OR POSITION THE PEN)
C              SYMBOL - CALCOMP ROUTINE(DRAW A SYMBOL, CHARACTER, OR
C             CHARACTER STRING)
C              NEWPEN - CALCOMP ROUTINE (CHANGE THE PEN COLOR)
C
C        INPUT FROM -
C              (NONE)
C
C        OUTPUT TO -
C              UNIT  7 - PLOTTER DATA
C
C        PARAMETERS -
C              X - ARRAY OF X VALUES TO BE PLOTTED
C              Y - ARRAY OF Y VALUES TO BE PLOTTED
C
C
      SUBROUTINE CBMCP2(X,Y)
      REAL X(1),Y(1)
      COMMON/CBMXYZ/ KEYTAB(3,250),NLNKS,MINTAN(2,40),
     1    MAXTAN(2,40),NKEY,NXYZ,ICOLOR(4),FLESH,FACTR,SCLE
      INTEGER HIER(20),FLESH
C
C   PLOT MAN-MODEL AND CREW STATION
C
C   CALCULATE PLOTTING FACTOR
      SCALE=FACTR/SCLE
      IF(FACTR.EQ.99.) SCALE=1.
      CALL FACTOR(SCALE)
C
C   PLOT THE LINK SYSTEM
C
      J=IABS(KEYTAB(2,1))
      HIER(J)=1
      CALL PLOT(X(1),Y(1),3)
      DO 50 I=2,NLNKS
C
C   SPECIFY COLOR FOR LINK SYSTEM
      CALL NEWPEN(ICOLOR(2))
C
       J=IABS(KEYTAB(2,I))
       K=KEYTAB(1,I)
      HIER(J)=I
C   LOCATE COORDINATE OF PREVIOUS POINT IN THE CHAIN
      L=HIER(J-1)
       CALL PLOT(X(L),Y(L),3 )
   10  M=2
```

```
C    CHECK IF OMIT OR INCLUDE STATUS
        IF (KEYTAB(2,I).LT.0.AND.KEYTAB(3,I).LT.0) M=3
        CALL PLOT(X(I),Y(I),M)
        J=IABS(KEYTAB(3,I))
        IF (J.EQ.1) GO TO 50
C
C    PLOT ENFLESHED MAN-MODEL
       IF(FLESH.EQ.1)  GO TO 50
   30 KP=KEYTAB(1,I)+NLNKS-1
C
C    SPECIFY COLOR FOR ENFLESHMANT
C
       CALL NEWPEN(ICOLOR(3))
       L1=KP+KEYTAB(3,2)-2
   35  DO 45 L2=KP,L1
         CALL SYMBOL(X(L2)-.04,Y(L2),.175,1H.,0.0,1,.175,0)
   45  CONTINUE
        IF (MINTAN(1,I).EQ.0) GO TO 50
        L1=MINTAN(1,I)+NLNKS
        L2=MINTAN(2,I)+NLNKS
        CALL PLOT(X(L1),Y(L1),3)
        CALL PLOT(X(L2),Y(L2),2)
        L1=MAXTAN(1,I)+NLNKS
        L2=MAXTAN(2,I)+NLNKS
        CALL PLOT(X(L1),Y(L1),3)
        CALL PLOT(X(L2),Y(L2),2)
   50 CONTINUE
C
C    PLOT CREW STATION PANELS
C
       IF (NLNKS.EQ.NKEY) RETURN
       II=NLNKS+1
C
C    SPECIFY COLOR FOR CREW STATION
C
       CALL NEWPEN(ICOLOR(4))
       DO 80 I=II,NKEY
        K=KEYTAB(1,I)+NXYZ+NLNKS
        CALL PLOT(X(K),Y(K),3)
        M=2
        IF (KEYTAB(2,I).LT.0.AND.KEYTAB(3,I).LT.0) M=3
        J=IABS(KEYTAB(3,I))
        L=K+1
        K=K+J-1
        DO 60 J=L,K
   60   CALL PLOT(X(J),Y(J),M)
   80 CONTINUE
       RETURN
       END
```

APPENDIX C-6

COMBIMAN SOURCE - CBMCDM LISTING

```
C* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C
C     CBMCDM - CREW STATION DATABASE MAINTENANCE MAIN ROUTINE
C
C        CALLS -
C             CBMCDP - HEADING AND PAGE CONTROL
C             CBMDAT - DATE AND TIME FROM SYSTEM
C             CBMDT4 - COMPUTES DETERMINANT OF A 4X4 MATRIX
C             CBMTRN - TRANSLATES COORD FROM AC TO SRP SYSTEM
C
C        INPUT FROM -
C             UNIT  1 - CREW STATION DATA BASE
C             UNIT  5 - COMMAND & DATA STATEMENTS
C
C        OUTPUT TO -
C             UNIT  1 - CREW STATION DATA BASE
C             UNIT  6 - PRINTER
C             UNIT  7 - CARD PUNCH
C
C        NOTE SIGNIFICANCE OF TYPE CODES AS FOLLOWS:
C             0,1 - STANDARD WORKPLACE PANEL
C             2   - SEAT
C             3   - RUDDER/BRAKE PEDAL
C             4   - CONTROL STICK
C             5   - THROTTLE
C             6   - COLLECTIVE
C             7   - WHEEL-TYPE
C
C        THE MAXIMUM NUMBER OF TYPE CODES FOR SPECIAL PROCESSING
C          IS 15.
C
C* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C
      DEFINE FILE 1(2000,92,U,IAV1)
C
      COMMON /CBMWDC/ IMT,IDY,IYR,IHR,IMN,ISC,IPG,ILN
C
      INTEGER MAXREC/2000/,IWKSP/4HWKSP/,BLANK/4H    /,PNN,
     1          IDEL/4H$DEL/,IADD/4H$ADD/,IEND/4H$END/,
     2          IINT/4H$INT/,IPRT/4H$PRT/,IDMP/4H$DMP/,
     3          IPCH/4H$PCH/,ICHK/4H$CHK/,ICMP/4H$CMP/,
     4          IDUMP(23),IPX(6),IPY(6),IPZ(6),NAME(2),INAME(2),
     5          ITYP(6)/1HF,1HA,1HL,1HR,1HU,1HD/,
     6          ITYPE(6)/1,-1,2,-2,3,-3/,INTD(4)/2,21,22,21/,
     7          PNO(300),PNAME(2,300),PTYPE(300),PNVRT(300),
     8          CNAME(2,300),CTYPE(300),CPNL(300),CPT(300),NPNLT(15)
C
      REAL BCSXYZ(3),CXYZ(3,300),ORIGIN(3),PXYZ(3,6,300),
     1     PX(6),PY(6),PZ(6)
C
      CALL CBMDAT(IMT,IDY,IYR,I,IHR,IMN,ISC)
      IPG=0
C                            PAGE COUNTER
C-----------------------------------------------------------------
C               READ COMMAND CARD AND PROCESS IT
C        TERMINATE PROGRAM IF COMMAND (IOPER) IS INVALID
C-----------------------------------------------------------------
   10 READ (5,1000,END=720) IOPR,NAME,NPNLS,NCTLS,BCSXYZ,IX,IY,IZ
      IF (IOPR.EQ.ICHK) GO TO 15
      IF (IOPR.EQ.IADD) GO TO 20
      IF (IOPR.EQ.IDEL) GO TO 200
```

```
      IF (ICPR.EQ.IINT) GO TO 250
      IF (ICPR.EQ.IPRT) GO TO 300
      IF (ICPR.EQ.ICMP) GO TO 400
      IF (ICPR.EQ.IPCH) GO TO 500
      IF (ICPR.EQ.ICMP) GO TO 600
      IF (ICPR.EQ.IEND) GO TO 700
C                                       INVALID COMMAND
      CALL CBMCDP(0)
      WRITE (6,1001) IOPR,NAME,NPNLS,NCTLS,BCSXYZ,IX,IY,IZ
      WRITE (6,2000) IOPR
      STOP
C                                        END PROGRAM
C------------------------------------------------------------------
C                  CHECK CREW STATION DATA MEMBER
C------------------------------------------------------------------
   15 CONTINUE
      JCHK = -2147483647
C                                       JCHK CONTROLS WRITE TO DATA BASE
      GO TO 21
C
C------------------------------------------------------------------
C            ADD CREW STATION DATA MEMBER
C------------------------------------------------------------------
   20 CONTINUE
      JCHK = 0
   21 CONTINUE
      CALL CBMCDP(0)
      WRITE (6,1001) IOPR,NAME,NPNLS,NCTLS,BCSXYZ,IX,IY,IZ
      DO 22 I=1,15
       NPNLT(I) = 0
C                                       CLEAR PANEL TYPE-COUNT ARRAY
   22 CONTINUE
      IF (NAME(1).NE.BLANK.OR.NAME(2).NE.BLANK) GO TO 23
C                                       BLANK CREW STATION NAME READ
      CALL CBMCDP(1)
      WRITE (6,2005) IOPR
      GO TO 10
C                                       READ NEXT COMMAND CARD
   23 CONTINUE
      IF (NPNLS.GE.1.AND.NPNLS.LE.300.AND.NCTLS.GE.1.AND.NCTLS.LE.300)
     1          GO TO 25
C                                       CHECK NUMBER OF PANELS AND CONTROLS
      CALL CBMCDP(1)
      WRITE (6,2007) NAME
C                                       ERROR IN PANEL OR CONTROL COUNTS
      GO TO 10
C                                       READ NEXT COMMAND CARD
   25 CONTINUE
      DO 30 I=1,6
       IF (IX.EQ.ITYP(I)) GO TO 40
C                                       CHECK X AXIS DIRECTION
   30 CONTINUE
      CALL CBMCDP(1)
      WRITE (6,2008) IX,NAME
C                                       WRONG X AXIS DIRECTION
      GO TO 10
C                                       READ NEXT COMMAND CARD
   40 CONTINUE
      IX1 = IABS(ITYPE(I))
      IX2 = ISIGN(1,ITYPE(I))
      DO 50 I=1,6
```

```
      IF (IY.EQ.ITYP(I)) GO TO 60
C                                  CHECK Y AXIS DIRECTION
   50 CONTINUE
      CALL CBMCDP(1)
      WRITE (6,2009) IY,NAME
C                                  WRONG Y AXIS DIRECTION
      GO TO 10
C                                  READ NEXT COMMAND CARD
   60 CONTINUE
      IY1 = IABS(ITYPE(I))
      IY2 = ISIGN(1,ITYPE(I))
      DO 70 I=1,6
      IF (IZ.EQ.ITYP(I)) GO TO 72
C                                  CHECK Z AXIS DIRECTION
   70 CONTINUE
      CALL CBMCDP(1)
      WRITE (6,2010) IZ,NAME
C                                  WRONG Z AXIS DIRECTION
      GO TO 10
C                                  READ NEXT COMMAND CARD
   72 CONTINUE
      IZ1 = IABS(ITYPE(I))
      IZ2 = ISIGN(1,ITYPE(I))
      IF (IX1.NE.IY1.AND.IX1.NE.IZ1.AND.IY1.NE.IZ1) GO TO 74
C                                  CHECK FOR UNIQUE X, Y, & Z DIRECTIONS
      CALL CBMCDP(1)
      WRITE (6,2011) NAME
      GO TO 10
C                                  X, Y, & Z DIRECTIONS NOT UNIQUE
   74 CONTINUE
      READ (I'1,ERR=810) JWKSP,II1,II2,ID1,ID2,MAX
C                                  READ FIRST RECORD ON DATA BASE
      IF (JWKSP.NE.IWKSP) GO TO 810
C                                  CHECK CREW STATION DATA BASE IDENTIFIER
      IF (ID2+NPNLS+NCTLS-1.LE.MAX) GO TO 76
C                                  CHECK IF THERE IS SAPCE TO ADD DATA
      CALL CBMCDP(1)
      WRITE (6,2001) NAME
C                                  PRINT - NO SPACE TO ADD DATA
      JCFK = JCFK+1
   76 CONTINUE
      IBDE = 0
C                                  INITIALIZE DIRECTORY RECORD COUNTER
C-----------------------------------------------------------------
C          READ RECORDS IN THE DIRECTORY AND CHECK MEMBERNAME
C          ENTRIES.  IF THE NAME READ FROM INPUT EXISTS ON THE
C          DIRECTORY THE NEW MEMBER IS NOT ADDED.  IF THERE IS
C          SPACE ON THE DIRECTORY AGAIN THE DATA IS NOT ADDED.
C-----------------------------------------------------------------
      DO 80 I=II1,II2
      READ (I'I,ERR=850) INAME,ID3,ID4,IPNLS,ICTLS,ORIGIN
      IF (NAME(1).EQ.INAME(1).AND.NAME(2).EQ.INAME(2))
     1    GO TO 800
C                                  MEMBER NAME EXISTS - CANNOT ADD DATA
      IF (INAME(1).EQ.BLANK.AND.INAME(2).EQ.BLANK) IBDE=I
   80 CONTINUE
      IF (IBDE.NE.0) GO TO 82
      CALL CBMCDP(1)
      WRITE (6,2012) NAME
C                                  PRINT - DIRECTORY IS FULL
      JCFK = JCFK+1
```

```
   82 CONTINUE
      ID3 = ID2+1
      ID4 = ID2+NPNLS+NCTLS
      CALL CBMCCP(3)
      WRITE (6,2019) NAME,NPNLS,NCTLS,BCSXYZ,IX,IY,IZ
C-----------------------------------------------------------------
C          READ COORDINATE DATA FOR ALL PANELS AND PROCESS
C-----------------------------------------------------------------
      DO 110 I=1,NPNLS
       READ (5,1002,END=720) PNO(I),(PNAME(J,I),J=1,2),PTYPE(I),
     1                  PNV,(PX(J),PY(J),PZ(J),J=1,PNV)
       K = I-1
       DO 83 J=1,K
        IF (I.NE.1.AND.PNO(J).EQ.PNO(I)) GO TO 84
C                                CHECK FOR UNIQUE PANEL NUMBER
   83  CONTINUE
       GO TO 86
   84  CONTINUE
       CALL CBMCCP(1)
       WRITE (6,2025) (PNAME(L,I),L=1,2),(PNAME(L,J),L=1,2)
       JCHK = JCHK+1
   86  CONTINUE
       IF (I.EQ.1) GO TO 89
       DO 87 J=1,K
        IF (PNAME(1,J).EQ.PNAME(1,I).AND.PNAME(2,J).EQ.PNAME(2,I))
     1           GO TO 88
C                                CHECK FOR UNIQUE PANEL NAME
   87  CONTINUE
       GO TO 89
   88  CONTINUE
       CALL CBMCCP(1)
       WRITE (6,2024) (PNAME(L,I),L=1,2),PNO(J),PNO(I)
       JCHK=JCHK+1
   89  CONTINUE
       IF (PTYPE(I).LT.0.OR.PTYPE(I).GT.15) GO TO 92
C                                CHECK FOR VALID PANEL TYPE
       IF (PTYPE(I).EQ.0) PTYPE(I)=1
C                                COUNTER FOR PANEL TYPES
       NPNLT(PTYPE(I)) = NPNLT(PTYPE(I))+1
       GO TO 93
   92  CONTINUE
       CALL CBMCCP(1)
       WRITE (6,2033) PTYPE(I),(PNAME(J,I),J=1,2)
   93  CONTINUE
       IF (PNV.GE.3.AND.PNV.LE.6) GO TO 94
C                                CHECK FOR NUMBER OF VERTICES
       WRITE (6,2020) PNV,(PNAME(J,I),J=1,2)
       IF (PNV.LT.3) PNV=3
       IF (PNV.GT.6) PNV=6
C                                THE ABOVE TWO STATEMENTS MAY APPEAR
C                                AS FUDDING. IN FACT, THEY ARE MEANT
C                                TO BE DEBUGGING AIDS.
       JCHK = JCHK+1
   94  CONTINUE
       IF (PNV.LT.4) GO TO 98
C-----------------------------------------------------------------
C           CHECK IF THE VERTICES ARE COLINEAR
C-----------------------------------------------------------------
       I1 = PNV-3
       I2 = PNV-2
       I3 = PNV-1
```

```
      DO 95 J1=1,I1
       DO 95 J2=2,I2
        DO 95 J3=1,I3
         DO 95 J4=4,PNV
          IF (J4.LE.J3.OR.J3.LE.J2.OR.J2.LE.J1) GO TO 95
          D = CBMDT4(PX(J1),PY(J1),PZ(J1),1.0,PX(J2),PY(J2),PZ(J2),
     1        1.0,PX(J3),PY(J3),PZ(J3),1.0,PX(J4),PY(J4),PZ(J4),1.0)
          IF (ABS(D).LE.0.10) GO TO 95
          CALL CBMLOP(1)
          WRITE (6,2027) (PNAME(J,I),J=1,2),J1,J2,J3,J4,D
   95 CONTINUE
   98 CONTINUE
      PNVRT(I) = PNV
C-----------------------------------------------------------------
C          TRANSLATE COORDINATES TO SRP SYSTEM AND
C          WRITE TO DATA BASE IF NO ERRORS
C-----------------------------------------------------------------
      DO 100 J=1,PNV
       CALL CBMTRN(PX(J),PY(J),PZ(J),PXYZ(1,J,I),BCSXYZ,
     1             IX1,IY1,IZ1,IX2,IY2,IZ2)
  100 CONTINUE
      CALL CBMLOP(PNV+1)
      WRITE (6,1003) PNO(I),(PNAME(J,I),J=1,2),PTYPE(I),PNV,
     1      (PX(J),PY(J),PZ(J),(PXYZ(K,J,I),K=1,3),J=1,PNV)
      IF (JCHK.EQ.0)
     1   WRITE (1'ID2+I) PNO(I),(PNAME(J,I),J=1,2),PTYPE(I),
     2                   PNV,((PXYZ(K,J,I),K=1,3),J=1,PNV)
  110 CONTINUE
C                             END OF LOOP FOR THE PANEL DATA
C-----------------------------------------------------------------
C          READ AND PROCESS COORDINATE DATA FOR CONTROLS
C-----------------------------------------------------------------
     CALL CBMLOP(1)
     WRITE (6,1012)
     DO 150 I=1,NCTLS
      READ (5,1004,END=720)
     1     (CNAME(J,I),J=1,2),CTYPE(I),CPNL(I),CPT(I),C1,C2,C3
      IF (CPNL(I).NE.0) GO TO 115
C                             NE.0 ==> DEFINED RELATIVE TO A PANEL
      IF (CPT(I).EQ.0) GO TO 135
C                             EQ.0 ==> DEFINED IN ABSOLUTE COORD
      WRITE (6,2013) (CNAME(J,I),J=1,2)
C                             ERROR IN DEFINITION OF COORD SYSTEM
      JCHK = JCHK+1
      GO TO 117
  115 CONTINUE
      DO 116 IPNL=1,NPNLS
       IF (PNO(IPNL).EQ.CPNL(I)) GO TO 120
C                             CHECK IF DEFINED PANEL EXISTS
  116  CONTINUE
      CALL CBMLOP(1)
      WRITE (6,2002) CPNL(I),(CNAME(J,I),J=1,2)
C                             DEFINED PANEL DOES NOT EXIST
      JCHK = JCHK+1
  117 CONTINUE
      CPNL(I) = 0
      CPT(I) = 0
      GO TO 135
  120 CONTINUE
      IF (CPT(I).GE.1.AND.CPT(I).LE.PNVRT(IPNL)) GO TO 130
C                             CHECK IF DEFINED VERTEX EXISTS
```

```
      CALL CBMCDP(I)
      WRITE (6,2003) CPT(I),(CNAME(J,I),J=1,2)
C                             DEFINED VERTEX DOES NOT EXIST
      CPT(I) = 1
      JCHK = JCHK+1
  130 CONTINUE
      IF (C3.EQ.0.0) GO TO 131
C                             FOR RELATIVE DEFN. Z COORD IS 0.0
      CALL CBMCDP(I)
      WRITE (6,2004) (CNAME(J,I),J=1,2)
      CPNL(I) = 0
      CPT(I) = 0
      JCHK = JCHK+1
      GO TO 135
  131 CONTINUE
      CXYZ(4,I) = C1
      CXYZ(5,I) = C2
C-----------------------------------------------------------------
C       COMPUTE ABSOLUTE COORDINATES FROM RELATIVE COORDINATE
C-----------------------------------------------------------------
      IC = CPT(I)
      IB = IC-1
      IA = IC+1
      IF (IA.EQ.PNVRT(IPNL)+1) IA=1
      IF (IB.EQ.0) IB=PNVRT(IPNL)
      CX = SQRT((PXYZ(1,IB,IPNL)-PXYZ(1,IC,IPNL))**2+
     1          (PXYZ(2,IB,IPNL)-PXYZ(2,IC,IPNL))**2+
     2          (PXYZ(3,IB,IPNL)-PXYZ(3,IC,IPNL))**2)
      DY = SQRT((PXYZ(1,IA,IPNL)-PXYZ(1,IC,IPNL))**2+
     1          (PXYZ(2,IA,IPNL)-PXYZ(2,IC,IPNL))**2+
     2          (PXYZ(3,IA,IPNL)-PXYZ(3,IC,IPNL))**2)
      T1 = ABS(C1)/CX
      T2 = ABS(C2)/DY
      T3 = 1.0-T1-T2
      DO 134 J=1,3
       CXYZ(J,I) = T1*PXYZ(J,IB,IPNL) + T2*PXYZ(J,IA,IPNL) +
     1             T3*PXYZ(J,IC,IPNL)
  134 CONTINUE
      GO TO 142
  135 CONTINUE
      IPNL = 0
      CXYZ(4,I) = 0.0
      CXYZ(5,I) = 0.0
C-----------------------------------------------------------------
C          TRANSLATE COORDINATES TO SRP SYSTEM
C-----------------------------------------------------------------
      CALL CBMTRN(C1,C2,C3,CXYZ(1,I),BCSXYZ(I),IX1,IY1,IZ1,
     1            IX2,IY2,IZ2)
  142 CONTINUE
      IF (I.EQ.1) GO TO 145
      K = I-1
      DO 141 J=1,K
       IF (CNAME(1,J).EQ.CNAME(1,I).AND.CNAME(2,J).EQ.CNAME(2,I))
     1         GO TO 146
C                             CHECK IF CONTROL NAME IS UNIQUE
  141 CONTINUE
      GO TO 145
  146 CONTINUE
      CALL CBMCDP(I)
      WRITE (6,2026) (CNAME(K,I),K=1,2)
C                             DUPLICATE CONTROL NAME
```

```
      JCHK = JCHK+1
  145 CONTINUE
      INAME(1) = BLANK
      INAME(2) = BLANK
      IF (IPNL.EQ.0) GO TO 147
C                                CHECK IF CONTROL DEFINED ABSOLUTELY
      INAME(1) = PNAME(1,IPNL)
      INAME(2) = PNAME(2,IPNL)
  147 CONTINUE
      CALL CBMCDP(1)
      WRITE (6,1005)
     1      (CNAME(J,I),J=1,2),CTYPE(I),INAME,CPT(I),C1,C2,C3,
     2      (CXYZ(J,I),J=1,5)
      K = ID2+NPNLS+I
      IF (JCHK.EQ.0)
     1    WRITE (1'K) (CNAME(J,I),J=1,2),CTYPE(I),CPNL(I),
     2                CPT(I),(CXYZ(J,I),J=1,5)
  150 CONTINUE
C                                END OF LOOP TO PROCESS CONTROL DATA
C-----------------------------------------------------------------
C           WRITE DIRECTORY BLOCK FOR ADD FUNCTION
C-----------------------------------------------------------------
     IF (JCHK) 180,160,170
  160 CONTINUE
     WRITE (1'IDDE) NAME,ID3,ID4,NPNLS,NCTLS,BDSXYZ,IX,IY,IZ
     ID2 = ID4
     WRITE (1'I) JWKSP,II1,II2,ID1,ID2,MAX
     WRITE (6,2028) NAME,NPNLS,NCTLS
     GO TO 10
C                                READ NEXT COMMAND CARD
  170 CONTINUE
     WRITE (6,2029) NAME,JCHK
C                                MEMBER NOT ADDED DUE TO ERRORS
     GO TO 10
C                                READ NEXT COMMAND CARD
C-----------------------------------------------------------------
C           PRINT MEMBER NAME AND NUMBER OF ERRORS
C           FOR CHECK FUNCTION
C-----------------------------------------------------------------
  180 CONTINUE
     JCHK = JCHK+2147483647
     WRITE (6,2030) NAME,JCHK
     GO TO 10
C                                READ NEXT COMMAND CARD
C
C-----------------------------------------------------------------
C             DELETE A MEMBER FROM DATA BASE
C-----------------------------------------------------------------
 200 CONTINUE
     CALL CBMCDP(0)
     WRITE (6,1001) IOPR,NAME
     IF (NAME(1).NE.BLANK.OR.NAME(2).NE.BLANK) GO TO 210
C                                CHECK IF NAME IS BLANK
     WRITE (6,2003) IOPR
C                                DELETE IGNORED
     GO TO 10
C                                READ NEXT COMMAND CARD
  210 CONTINUE
     READ (1'1,ERR=810) JWKSP,II1,II2,ID1,ID2,MAX
     IF (JWKSP.NE.IWKSP) GO TO 810
C                                CHECK FOR VALID DATA BASE
```

```
      DO 220 I=II1,II2
       READ (1'I,ERR=850) INAME,ID3,ID4,IPNLS,ICTLS,ORIGIN,IX,IY,IZ
C                               READ DIRECTORY BLOCKS
       IF (NAME(1).EQ.INAME(1).AND.NAME(2).EQ.INAME(2)) GO TO 230
C                               CHECK FOR MEMBER NAME
  220 CONTINUE
      WRITE (6,2006) NAME
C                               MEMBER NAME DOES NOT EXIST
      GO TO 10
C                               READ NEXT COMMAND CARD
  230 CONTINUE
      WRITE (6,1007) NAME
C                               MEMBER NAME EXISTS
      ID5 = 0
      WRITE (1'I) BLANK,BLANK,(ID5,J=1,10)
C                               DELETE MEMBER NAME FROM DIRECTORY
      GO TO 10
C                               READ NEXT COMMAND CARD
C
C-----------------------------------------------------------------
C                    INITIALIZE DATA BASE
C-----------------------------------------------------------------
  250 CONTINUE
      CALL CBMCCP(0)
      WRITE (6,1001) IOPR
      WRITE (6,1008)
      WRITE (1'1) IWKSP,INTD,MAXREC
C                               WRITE FIRST RECORD ON DATA BASE
      II1 = INTD(1)
      II2 = INTD(2)
      J = 0
      DO 260 I=II1,II2
  260  WRITE (1'I) BLANK,BLANK,(J,K=1,10)
C                               ENTER BLANKS FOR MEMBER NAMES
      GO TO 10
C                               READ NEXT COMMAND CARD
C
C-----------------------------------------------------------------
C          PRINT CREW STATION DATA BASE - IF INPUT MEMBER NAME
C          DOES NOT EXIST, THE DIRECTORY IS PRINTED
C-----------------------------------------------------------------
  300 CONTINUE
      CALL CBMCCP(0)
      WRITE (6,1001) IOPR,NAME
      READ (1'1,ERR=810) JWKSP,II1,II2,ID1,ID2,MAX
C                               READ HEADER RECORD OF DATA BASE
      IF (JWKSP.NE.IWKSP) GO TO 810
C                               CHECK FOR VALID DATA BASE
      IF (NAME(1).EQ.BLANK.AND.NAME(2).EQ.BLANK) GO TO 360
C                               CHECK IF INPUT NAME IS BLANK
      DO 310 I=II1,II2
       READ (1'I,ERR=850) INAME,ID3,ID4,NPNLS,NCTLS,ORIGIN,IX,IY,IZ
C                               READ DIRECTORY BLOCKS
       IF (NAME(1).EQ.INAME(1).AND.NAME(2).EQ.INAME(2)) GO TO 320
C                               CHECK IF MEMBER NAME EXISTS
  310  CONTINUE
      GO TO 350
C                               MEMBER NAME DOES NOT TALLY
  320 CONTINUE
      ID5 = ID3+NPNLS-1
      CALL CBMCCP(1)
```

```
      WRITE (6,1011) I,INAME,ID3,ID4,NPNLS,NCTLS,ORIGIN,IX,IY,IZ
C                              PRINT DIRECTORY INFO FOR MEMBER
      DO 330 I=ID3,ID5
       K = I-ID3+1
       READ (1'I,ERR=880) PNO(K),(PNAME(J,K),J=1,2),PTYPE(K),PNV,
     1        ((PXYZ(L,J,K),L=1,3),J=1,PNV)
       PNVRT(K) = PNV
       CALL CBMCOP(PNV+1)
       WRITE (6,1009) PNO(K),(PNAME(J,K),J=1,2),PTYPE(K),PNV,
     1        ((PXYZ(L,J,K),L=1,3),J=1,PNV)
C                              WRITE PANEL DATA
  330 CONTINUE
      WRITE (6,1010)
      ID5 = ID5+1
      DO 340 I=ID5,ID4
       READ (1'I,ERR=880) INAME,JTYP,IPNL,IPT,C1,C2,C3,C4,C5
       IF (IPNL.EQ.0) GO TO 334
       DO 333 J = 1,NPNLS
        IF (IPNL.EQ.PNO(J)) GO TO 335
  333  CONTINUE
  334  CONTINUE
       NAME(1) = BLANK
       NAME(2) = BLANK
       GO TO 337
  335  CONTINUE
       NAME(1) = PNAME(1,J)
       NAME(2) = PNAME(2,J)
  337  CONTINUE
       CALL CBMCOP(1)
       WRITE (6,1006) INAME,JTYP,NAME,IPT,C1,C2,C3,C4,C5
C                              WRITE DATA FOR CONTROLS
  340 CONTINUE
      GO TO 10
C                              READ NEXT COMMAND CARD
  350 CONTINUE
      CALL CBMCOP(1)
      WRITE (6,2006) NAME
C                              PRINT - MEMBER NOT FOUND
  360 CONTINUE
      DO 370 I=I11,I12
       READ (1'I,ERR=850) INAME,ID3,ID4,NPNLS,NCTLS,ORIGIN,IX,IY,IZ
       IF (INAME(1).EQ.BLANK.AND.INAME(2).EQ.BLANK) GO TO 370
       CALL CBMCOP(1)
       WRITE (6,1011) I,INAME,ID3,ID4,NPNLS,NCTLS,ORIGIN,IX,IY,IZ
C                              PRINT DIRECTORY BLOCKS
  370 CONTINUE
      GO TO 10
C                              READ NEXT COMMAND CARD
C
C-----------------------------------------------------------------
C          DUMP CREW STATION DATA SET - IF INPUT MEMBER NAME
C          IS BLANK, DUMP THE ENTIRE DATA BASE
C-----------------------------------------------------------------
  400 CONTINUE
      CALL CBMCOP(0)
      WRITE (6,1001) IDPR,NAME
      IF (NAME(1).NE.BLANK.OR.NAME(2).NE.BLANK) GO TO 420
C                              CHECK IF INPUT NAME IS BLANK
      DO 410 I=1,MAXREC
       READ (1'I) IDUMP
       CALL CBMCOP(3)
```

```
      WRITE (6,1013) I,IDUMP,IDUMP
  410 CONTINUE
C                                DUMP DATA BASE IF INPUT IS BLANK
      GO TO 10
C                                READ NEXT COMMAND CARD
  420 CONTINUE
      READ (1'1,ERR=810) JWKSP,I11,I12,ID1,ID2,MAX
      IF (JWKSP.NE.IWKSP) GO TO 810
C                                CHECK FOR VALID CREW STATION
      DO 430 I=I11,I12
       READ (1'I,ERR=850) INAME,ID3,ID4,NPNLS,NCTLS,ORIGIN,IX,IY,IZ
       IF (INAME(1).EQ.NAME(1).AND.INAME(2).EQ.NAME(2)) GO TO 440
C                                CHECK DIRECTORY FOR MEMEBER NAME
  430  CONTINUE
      WRITE (6,2006) NAME
C                                MEMBER NAME DOES NOT EXIST
      GO TO 10
C                                READ NEXT COMMAND CARD
  440 CONTINUE
      CALL CBMCCP(1)
      WRITE (6,1011) I,INAME,ID3,ID4,NPNLS,NCTLS,ORIGIN,IX,IY,IZ
C                                PRINT DIRECTORY INFO OF MEMBER
      DO 450 I=ID3,ID4
       READ (1'I) IDUMP
       CALL CBMCCP(3)
       WRITE (6,1013) I,IDUMP,IDUMP
C                                DUMP MEMBER DATA
  450 CONTINUE
      GO TO 10
C                                READ NEXT COMMAND CARD
C
C-------------------------------------------------------------------
C           PUNCH CREW STATION DATA BASE MEMBER
C-------------------------------------------------------------------
  500 CONTINUE
      CALL CBMCCP(J)
      WRITE (6,1001) IOPR,NAME
      READ (1'1,ERR=810) JWKSP,I11,I12,ID1,ID2,MAX
      IF (JWKSP.NE.IWKSP) GO TO 810
C                                CHECK FOR VALID DATA BASE
      IF (NAME(1).EQ.BLANK.AND.NAME(2).EQ.BLANK) GO TO 560
C                                CHECK IF INPUT MEMBER NAME IS BLANK
      DO 510 I=I11,I12
       READ (1'I,ERR=850) INAME,ID3,ID4,NPNLS,NCTLS,ORIGIN,IX,IY,IZ
       IF (NAME(1).EQ.INAME(1).AND.NAME(2).EQ.INAME(2)) GO TO 520
C                                CHECK IF NAMES TALLY
  510 CONTINUE
      WRITE (6,2006) NAME
C                                NAMES DO NOT TALLY
      GO TO 10
C                                READ THE NEXT COMMAND CARD
  520 CONTINUE
      ID5 = ID3+NPNLS-1
      WRITE (7,1014) NAME,NPNLS,NCTLS
      DO 530 I=ID3,ID5
       READ (1'I,ERR=860) INO,INAME,JTYP,INV,
     1             (PX(J),PY(J),PZ(J),J=1,INV)
C                                READ PANEL DATA FROM DATA BASE
       DO 528 J=1,INV
        IPX(J) = IFIX(PX(J)*100.0)
        IPY(J) = IFIX(PY(J)*100.0)
```

```
        IPZ(J) = IFIX(PZ(J)*100.0)
C                                  CONVERT DATA TO INTEGER FORMAT
  528 CONTINUE
       WRITE (7,1015) INO,INAME,JTYP,INV,
     1                (IPX(J),IPY(J),IPZ(J),J=1,INV)
C                                  PUNCH PANEL DATA
  530 CONTINUE
      ID5 = ID3+NPNLS
      DO 540 I=ID5,ID4
       READ (1'I,ERR=880) INAME,JTYP,IPNL,IPT,C1,C2,C3,C4,C5
C                                  READ DATA FOR CONTROLS
       IF (IPNL.EQ.0) GO TO 535
C                                  CHECK IF DATA IS ABSOLUTE
       IC4 = IFIX(C4*100.0)
       IC5 = IFIX(C5*100.0)
       WRITE (7,1016) INAME,JTYP,IPNL,IPT,IC4,IC5
       GO TO 540
  535  CONTINUE
       IC1 = IFIX(C1*100.0)
       IC2 = IFIX(C2*100.0)
       IC3 = IFIX(C3*100.0)
       WRITE (7,1017) INAME,JTYP,IPNL,IPT,IC1,IC2,IC3
  540 CONTINUE
      WRITE (6,2021) NAME
C                                  PRINT PUNCH MESSAGE
      GO TO 10
C                                  READ NEXT COMMAND CARD
  500 CONTINUE
      WRITE (6,2005) ICPR
C                                  PRINT - NO NAME GIVEN
      GO TO 10
C                                  READ NEXT COMMAND CARD
C
C---------------------------------------------------------------
C          COMPRESS CREW STATION DATABASE FUNCTION
C       1. GOES THROUGH MEMBER LIST TO LOCATE LOWER MOST MEMBER
C       2. CHECKS IF THE MEMBER HAS LEFT A GAP
C       3. IF YES,  REWRITE MEMBER CLOSING THE GAP
C       4. DELETE MEMBER FROM MEMBER LIST AND GO TO 1
C---------------------------------------------------------------
  600 CONTINUE
      CALL CBMCCP(0)
      WRITE (6,1001) ICPR,NAME
      READ (1'1,ERR=810) JWKSP,II1,II2,ID1,ID2,MAX
      IF (JWKSP.NE.IWKSP) GO TO 810
C                                  CHECK FOR VALID CREW STATION
      IBTM = ID1
  610 CONTINUE
      ITOP = ID2
      II = 0
      DO 620 I=II1,II2
       READ (1'I,ERR=850) INAME,ID3,ID4,NPNLS,NCTLS,ORIGIN,IX,IY,IZ
       IF (ID3.GE.ITOP.OR.ID3.LT.IBTM .OR.
     1     (INAME(1).EQ.BLANK.AND.INAME(2).EQ.BLANK))
     2      GO TO 620
       II = I
       ITOP = ID3
  620 CONTINUE
      IF (II.EQ.0) GO TO 660
      READ (1'II,ERR=850) INAME,ID3,ID4,NPNLS,NCTLS,ORIGIN,IX,IY,IZ
      IF (ITOP.EQ.IBTM) GO TO 640
```

```
      K = ID3-1
      L = IBTM-1
      J = NPNLS+NCTLS
      DO 630 I=1,J
       READ (1'K+I,ERR=680) IDUMP
       WRITE (1'L+I) IDUMP
  630 CONTINUE
      ID3 = L+1
      ID4 = L+J
      WRITE (1'II) INAME,ID3,ID4,NPNLS,NCTLS,ORIGIN,IX,IY,IZ
      CALL CBMCOP(1)
      WRITE (6,2022) INAME
      IBTM = ID4+1
      GO TO 610
  640 CONTINUE
      CALL CBMCOP(1)
      WRITE (6,2023) INAME
      IBTM = ID4+1
      GO TO 610
  660 CONTINUE
      ID2 = IBTM-1
      WRITE (1'1) JWKSP,II1,II2,ID1,ID2,MAX
      WRITE (6,2032)
      GO TO 10
C                                 READ NEXT COMMAND CARD
C-----------------------------------------------------------------------
C                     END OF PROGRAM MESSAGES
C-----------------------------------------------------------------------
  700 CONTINUE
      CALL CBMCOP(0)
      WRITE (6,1001) ICPR
      WRITE (6,2099)
      STOP
C-----------------------------------------------------------------------
C                        END OF INPUT DATA
C-----------------------------------------------------------------------
  720 CONTINUE
      WRITE (6,2015)
      WRITE (6,2099)
      STOP
C-----------------------------------------------------------------------
C                        DUPLICATE MEMBER NAME
C-----------------------------------------------------------------------
  800 CONTINUE
      WRITE (6,2014) NAME
      GO TO 10
C-----------------------------------------------------------------------
C                     INVALID CREW STATION DATA BASE
C-----------------------------------------------------------------------
  810 CONTINUE
      WRITE (6,2031)
      WRITE (6,2099)
      STOP
  850 CONTINUE
      WRITE (6,2016) IAV1
C                                 WRONG INDEX RECORD
      STOP
  880 CONTINUE
      WRITE (6,2017) IAV1
C                                 WRONG DATA RECORD
      STOP
```

```
C-----------------------------------------------------------------
C                      FORMAT STATEMENTS
C-----------------------------------------------------------------
 1000 FORMAT(A4,1X,2A4,2I4,3F6.2,1X,A1,1X,A1,1X,A1)
 1001 FORMAT (9H CBM1001 ,A4,1X,2A4,2I4,3F6.2,1X,A1,1X,A1,1X,A1)
 1002 FORMAT(I3,2A4,I3,3X,I1,9F6.2,8X/12F6.2,8X)
 1003 FORMAT(I15,3H.) ,2A4,7H, TYPE=,I2,1H,,I2,20H VERTICES --INPUT CO,
     X       40HORDINATES---     --ABSOLUTE COORDINATES-/(48X,1H(,3F7.2,
     X       6H) TO (,3F7.2,1H)))
 1004 FORMAT(2A4,I6,I3,I1,3F6.2)
 1005 FORMAT(11X,2A4,I5,1X,2A4,I4,4H    (,3F7.2,6H) TO (,3F7.2,5H) & (,
     X       2F7.2,1H))
 1006 FORMAT(11X,2A4,I5,1X,2A4,I3,4H    (,3F7.2,5H)    (,2F7.2,1H))
 1007 FORMAT(9H CBM123I ,2A4,9H DELETED.)
 1008 FORMAT(21H CBM124I INITIALIZED.)
 1009 FORMAT(I15,3H.) ,2A4,7H, TYPE=,I2,1H,,I2,21H VERTICES --ABSOLUTE ,
     X       12HCOORDINATES-/(48X,1H(,3F7.2,1H)))
 1010 FORMAT(10X,51H CONTROL- TYPE IN-PANEL POINT --ABSOLUTE COORDINATE,
     X       23HS-  RELATIVE-COORDINATE/11X,8(1H-),6H ---- ,8(1H-),
     X       7H ----- ,23(1H-),2X,19(1H-))
 1011 FORMAT(I15,3H.) ,2A4,10H, EXTENT=(,I8,1H,,I8,2H),,I4,8H PANELS,,
     X       I4,19H CONTROLS, ORIGIN=(,F7.2,1H,,F7.2,1H,,F7.2,7H), ORIE,
     X       5HNT.=(,A1,1H,,A1,1H,,A1,2H).)
 1012 FORMAT(10X,51H CONTROL- TYPE IN PANEL POINT ---(INPUT COORDINATES-,
     X       51H--      --ABSOLUTE COORDINATES-  RELATIVE-COORDINATES/11X,
     X       8(1H-),6H ---- ,8(1H-),7H ----- ,23(1H-),4X,23(1H-),2X,
     X       19(1H-))
 1013 FORMAT(11X,6HRECORD,I5,3H+=+,23A4,3H+=+/11X,3H+=+,12Z8,3H+=+/11X,
     X       3H+=+,11Z8,3H+=+)
 1014 FORMAT(5H$ADD ,2A4,2I4,24H   0.0   0.0   0.0 F L U)
 1015 FORMAT(I3,2A4,3X,I3,I1,9I6,8X/12I6,8X)
 1016 FORMAT(2A4,I6,I3,I1,2I6,42X,8X)
 1017 FORMAT(2A4,I6,I3,I1,3I6,36X,8X)
C
 2000 FORMAT(9H CBM101A ,A4,19H-UNKNOWN OPERATION.)
 2001 FORMAT(30H CBM127A NO SPACE, CANNOT ADD ,2A4,1H.)
 2002 FORMAT(8H CBM102A,I4,35H, INVALID PANEL NUMBER FOR CONTROL ,2A4,
     X       1H.)
 2003 FORMAT(8H CBM103A,I4,36H, INVALID VERTEX NUMBER FOR CONTROL ,2A4,
     X       1H.)
 2004 FORMAT(55H CBM104A Z NOT ZERO, PANEL & VERTEX NOR ZERO FOR POINT
     X       ,2A4,1H.)
 2005 FORMAT(24H CBM105A NO NAME GIVEN, ,A4,10H, IGNORED.)
 2006 FORMAT(9H CBM106A ,2A4,11H NOT FOUND.)
 2007 FORMAT(54H CBM107A NUMBER OF PANELS/CONTROLS INVALID FOR MEMBER ,
     X       2A4,1H.)
 2008 FORMAT(9H CBM108A ,A1,26H FOR X INVALID, MEMBER IS ,2A4,1H.)
 2009 FORMAT(9H CBM109A ,A1,26H FOR Y INVALID, MEMBER IS ,2A4,1H.)
 2010 FORMAT(9H CBM110A ,A1,26H FOR Z INVALID, MEMBER IS ,2A4,1H.)
 2011 FORMAT(49H CBM111A X&Y, X&Z OR Y&Z ARE COLINEAR FOR MEMBER ,2A4)
 2012 FORMAT(39H CBM112A DIRECTORY IS FULL, CANNOT ADD ,2A4,1H.)
 2013 FORMAT(45H CBM113A PANEL IS ZERO, BUT POINT IS NOT FOR ,2A4,1H.)
 2014 FORMAT(9H CBM114A ,2A4,16H ALREADY EXISTS.)
 2015 FORMAT(21H CBM115A END-OF-DATA.)
 2016 FORMAT(28H CBM116A I/O ERROR ON RECORD,I5,9H (INDEX).)
 2017 FORMAT(28H CBM117A I/O ERROR ON RECORD,I5,8H (DATA).)
 2019 FORMAT(17H CBM119I MEMBER, ,2A4,5H, HAS,I4,8H PANELS,,
     1       4H AND,I4,10H CONTROLS./
     X       38H CBM120I COORDINATES ARE TRANSLATED TO,
     X       2H (,F7.2,1H,,F7.2,1H,,F7.2,2H)./22H CBM121I COORDINATES G
     X       8HIVEN AS ,A1,2H, ,A1,5H AND ,A1,21H ARE NOW F, L, AND U.)
```

```
2020 FORMAT(8H CBM125A,I2,39H IS AN INVALID NUMBER OF VERTICIES FOR ,
    X        2A4,1H.)
2021 FORMAT(9H CBM126I ,2A4,9H PUNCHED.)
2022 FORMAT(9H CBM129I ,2A4,14H NOW IN PLACE.)
2023 FORMAT(9H CBM128I ,2A4,14H WAS IN PLACE.)
2024 FORMAT(9H CBM130A ,2A4,15H USED IN PANELS,I4,4H AND,I4,1H.)
2025 FORMAT(9H CBM131A ,2A4,20H HAS SAME NUMBER AS ,2A4,1H.)
2026 FORMAT(9H CBM132A ,2A4,21H IS A DUPLICATE NAME.)
2027 FORMAT(9H CBM133A ,2A4,25H NOT PLANAR FOR VERTICIES,I2,1H,,I2,1H,,
    X        I2,4H AND,I2,17H, DETERMINATE IS ,E15.7)
2028 FORMAT(9H CBM134I ,2A4,5H WITH,I5,12H PANELS AND,,I5,
    X        25H CONTROLS HAS BEEN ADDED.)
2029 FORMAT(9H CBM135A ,2A4,17H NOT ADDED DUE TO,I5,10H ERROR(S).)
2030 FORMAT(16H CBM136I MEMBER ,2A4,9H CHECKED,,I5,10H ERROR(S).)
2031 FORMAT(49H CBM137A DATABASE IS NOT A CREW STATION DATABASE.)
2032 FORMAT(27H CBM138I COMPRESS FINISHED.)
2033 FORMAT(28H CBM139I INVALID PANEL TYPE,,I4,12H, FOR PANEL ,2A4,
    X        20H. (PANEL INPUT CARD))
2099 FORMAT(21H CBM122I PROGRAM END.)
     END
```

APPENDIX C-7

COMBIMAN SOURCE - IBMGLD LISTING

```
         TITLE  'IBMGLD'
IBMGLD   CSECT
     SPACE  3
***********************************************************************
*
**   THE IBMGLD CSECT IS DESIGNED TO CONVERT IBM 2250 GRAPHIC ORDER
*     PROGRAMS TO GOULD 'OR' CALCOMP TYPE PLOT ORDERS.
*    IT IS CALLED BY GSPGLD, WHICH SUPPLIES THE 2250 BUFFER TABLE AND
*     A COPY OF THE BUFFER IN MAIN STORAGE.
*    IBMGLD CREATES A 9.5" BY 9.5" GOULD PLOT COPY OF THE 2250 SCREEN.
*
*    FIRST WE WILL ISSUE A GETMAIN FOR A SAVE AREA FOR THIS ROUTINE,
*     WHICH MAKES THIS ROUTINE RE-ENTRANT AND  SERIALLY REUSABLE.
***********************************************************************
     SPACE  3
         USING   *,15          DEFINE BASE REG FOR REENTRANT STRT
         B       12(R0,R15)    SKIP OVER THE ROUTINE NAME
         DC      XL1'06'       DEFINE NAME LENGTH
         DC      C'IBMGLD'     DEFINE NAME
         STM     R14,R12,12(R13)  STORE THE CALLING PROGS REGS
         CNOP    0,4
         BAL     R1,*+8        SKIP OVER GETMAIN ARG LIST
         DC      A(72)         DEFINE LENGTH OF BYTES FOR SAVE AREA
         L       R0,0(R1,R0)   LOAD THE GETMAIN DATA INTO R0
         SVC     10            DO THE GETMAIN FOR A SAVE AREA
         DROP    15            DROP R15 AS BASE
     SPACE  3
***********************************************************************
*
*     SAVE THE CALLING PROGS SAVE ADDRESSES IN THE SAVE AREA CHAIN.
*
***********************************************************************
     SPACE  3
         LA      R14,12(R13)     LOAD  PREV SAVE AREA ADDR
         ST      R1,8(R13)   STORE OUR SAVE AREA ADDR
         ST      R13,4(R1)   STORE CALLIN SAVE AREA ADDR IN OUR SAVE
         LR      R13,R1   LOAD OUR SAVE AREA ADDRESS INTO THE SAVE REG
         LM      R14,R1,0(R14)    RELOAD THE LINKEAGE REGISTERS
         BALR    R12,0
         USING   *,12          DEFINE OUR BASE REGISTER
     EJECT
***********************************************************************
*                     REGISTER  EQUATES
***********************************************************************
R0       EQU     0
R1       EQU     1
R2       EQU     2                MAIN STORAGE BUFFER COPY
R3       EQU     3                BUFFER LENGTH/BUFFER RESTART ADDRESS
R4       EQU     4                BUFFER TABLE
R5       EQU     5
R6       EQU     6
R7       EQU     7
R8       EQU     8
R9       EQU     9
R10      EQU     10
R11      EQU     11
R12      EQU     12               BASE REGISTER
R13      EQU     13
R14      EQU     14
R15      EQU     15
F0       EQU     0
```

```
F2       EQU     2
F4       EQU     4
F6       EQU     6
***********************************************************************
      EJECT
***********************************************************************
*
*     SET UP AND CALL THE GOULD ENTRY 'RESRV'  TO RESERVE AT LEAST
*     40K BYTES OF CORE FOR THE USER ROUTINES.  OTHERWISE THE  GOULD
*     ROUTINES WILL ONLY SAVE ABOUT 15K.
*
***********************************************************************
      SPACE   3
          SR       R11,R11        CLEAR REG 11
          LM       R2,R4,0(R1)    LOAD IN THE INPUT ARGS
          LA       R1,RSVARGS     LOAD ADDRESS OF THE RESRV CALL
          L        R15,=V(RESRV)  LOAD ADDR OF RESRV ROUTINE
          BALR     R14,R15        RESERVE 40K BYTES FOR  MAIN POROG
      SPACE   3
***********************************************************************
*
*    CALL PLOTS TO DEFINE THE LIMITS OF OUR PLOTTING AREA AND TO
*    INITIALIZE THE PLOTTER ROUTINES.  THE LIMITS FOR THE PLOTTER
*     AREA ARE SET TO 10.0 FOR THE X AXIS, AND 10.0 ON THE Y-AXIS.
*
***********************************************************************
      SPACE   3
          LA       R1,PLTS         LOAD ADDRESS OF PLOTS ARG LIST
          L        R15,=V(PLOTS)   LOAD ENTRY POINT FOR PLOTS
          BALR     R14,R15         CALL PLOTS TO INITIALIZE PLOT PKG
          SPACE    3
*******************************************************************
*               MARGIN TOP AND BOTTOM ONE QUARTER INCH
*******************************************************************
          SPACE    3
          LA       R1,PLTLST3
          L        R15,=V(PLOT)
          BALR     R14,R15
      EJECT
***********************************************************************
*                         HOUSEKEEPING
***********************************************************************
      SPACE   3
          SER      F0,F0        CLEAR OUT THE X POSITION REG
          SER      F2,F2        CLEAR OUT THE Y POSITION REGISTER
          MVI      GSRTADD,X'00'
          MVC      GSRTADD+1(3),GSRTADD    CLEAR OUT GRST ADDRESS
          ST       R4,TABLE     SAVE THE BUFFER TABLE ADDRESS
          ST       R2,START     SAVE START ADDRESS OF MAIN CORE BUFFER
          LH       R4,0(R3)     LOAD THE BUFFER LENGTH BALUE
          AR       R4,R2        SAVE END ADDRESS OF MAIN CORE BUFFER
          LH       R11,2(R3)    LOAD THE BUFFER START ADDRESS(GDS)
          STH      R11,OFFSET
          BAL      R14,CNVRT    CONVERT TO CORE ADDRESS
      SPACE   3
***********************************************************************
*                      CHECK FOR GRAPHICS ORDER
***********************************************************************
      SPACE   3
CKNEXT    CLI      0(R2),X'2A'  CHECK FOR A GRAPHICS ORDER CODE
          BE       GORDER       IF FOUND GO PROCESS IT
```

```
INC      LA    R2,2(R2)        INCREMENT TO NEXT HALF WORD
         CR    R4,R2           SEE IF WE HAVE OVER RUN THE BUFFER
         BNL   CKNEXT          IF NOT GO CHECK THE NEXT HW
         B     EOBERR          IF SO GO INTO THE ERROR RETURN MODE
     SPACE   3
***********************************************************************
*                   CHECK FOR REGENERATION TIMER,
*                      BRANCH FOR PLOT ORDERS
***********************************************************************
     SPACE   3
GORDER   CLI   1(R2),X'E2'     SEE IF WE HAVE A GSRT CODE
         BL    PLTORDR         LOWER CODE REQUIRES PLOT ACTION
         BH    BYPASS          IF HI WE CHECK FOR GTRU AND GCNOP CODES
         C     R2,GSRTADD      END IF WE HAVE LOOPED
         BE    DONE
         ST    R2,GSRTADD      SAVE THE GSRT ADDRESS
         B     INC             AND GO LOOK FOR NEXT ORDER
     SPACE   3
***********************************************************************
*                     CHECK FOR BRANCHES(FF),
*               UPDATE R2 ACCORDING TO ORDER LENGTH
***********************************************************************
     SPACE   3
BYPASS   CLI   1(R2),X'FF'       Q. A GTRU CODE?
         BE    GTRU              A. YES. GO PROCESS
         CLI   1(R2),X'C0'       Q. LESS THAN C0? CHECK FOR 83-87
         BL    INC               A. YES. GO PINT TO NEXT HALF WORD
         CLI   1(R2),X'EB'       Q. LESS THAN EB? CHECK FOR C0 & EA
         BL    FOUR              A. YES. GO POINT TO NEXT WORD
         CLI   1(R2),X'FC'       Q. LESS THAN FC? CHECK FOR EB & EC
         BL    SIX               A. YES. GO POINT AWAY FROM 6 BYTES
FOUR     LA    R2,4(R2)
         B     CKNEXT
SIX      LA    R2,6(R2)
         B     CKNEXT            GO CHECK FOR THE NEXT ORDER CODE
     EJECT
***********************************************************************
*                 CHECK TO SEE IF WE HAVE LOOPED TO START,
*                            IF SO END
***********************************************************************
     SPACE   3
GTRU     LH    R11,2(R2)         LOAD THE GTRU BRANCH ADDR
         C     R11,OFFSET
         BE    DONE
         BAL   R14,CNVRT
         B     CKNEXT
     SPACE   3
***********************************************************************
*                 TRANSLATE BUFFER ADDRESS TO MAIN
*                         STORAGE ADDRESS
***********************************************************************
     SPACE   3
CNVRT    L     R2,START          LOAD START ADDRESS OF CORE
         L     R8,TABLE          LOAD BUFFER TABLE ADDRESS
GTLOOP   LA    R8,4(R8)          INCREMENT BUFFER ADDRESS
         LH    R10,0(R8)         LOAD BUFFER ADDRESS
         LTR   R10,R10           CHECK FOR END OF TABLE
         BL    EOBERR
         LH    R9,2(R8)          LOAD LENGTH OF BUFFER SEGMENT
         AR    R10,R9            FIND LIMIT OF SEGMENT
         CR    R11,R10           CORRECT SEGMENT?
```

```
         BNH   *+10
         AR    R2,R9               UPDATE MAIN STORAGE POINTER
         B     GTLOOP
         SR    R10,R9              R10 POINTS TO SEGMENT START IN BUFFER
         SR    R11,R10             R11 EQUALS OFFSET OF BRANCH ADDRESS
         AR    R2,R11              NEW MAIN STORAGE POINTER
         CR    R2,R4               SEE IF WE HAVE A END OF BUFFER ERROR
         BH    EOBERR              IF SO PROCESS THE ERROR
         BR    R14
    EJECT
***********************************************************************
*                   IF STOP REGENERATION ORDER,
*                          THEN END
***********************************************************************
    SPACE  3
PLTCROR  CLI   1(R2),X'80'   CHECK FOR A GNOP2 CODE
         BE    INC           IF SO SKIP TO NEXT CODE
         BH    DONE          WE HAVE AN END ORDER SEQUENCE
         CLI   1(R2),X'40'   CHECK FOR A TEST OR VECTOR COMMAND
         BL    VECTCRS       IF LOW WE HAVE VECTCRS
   SPACE  3
***********************************************************************
*                   PROCESS CHARACTER STRINGS
***********************************************************************
   SPACE  3
         LA    R5,2(R2)      COMPUTE THE ADDR OF THE 1ST CHARACTER
         LA    R6,WORK       LOAD ADDRESS FO OUR WORK AREA
L1       CLI   0(R5),X'2A'   TEST FOR A NEW GRAPHICS COMMAND
         BE    ENDCS         IF SO WE ARE AT END FO CHAR STRING
         CLI   0(R5),X'CC'   TEST FOR A NULL CHARACTER
         BNE   SAVECH        IF NOT THEN WE SAVE THIS CHAR
INCR5    LA    R5,1(R5)      INCREMENT TO THE NEXT CHARACTER
         CR    R4,R5         CHECK FOR END OF BUFFER
         BNL   L1            IF NOT EOB  GO CHECK NEXT CHAR
         B     EOBERR        OTHERWISE GO RETURN WITH ERROR INDICATION
SAVECH   MVC   0(1,R6),0(R5)  MOVE CHAR TO WORK AREA
         LA    R6,1(R6)      UNPDATE THE WORK AREA ADDRESS
         B     INCR5       GO UPDATE R5 AND CHECK NEXT CHAR
ENDCS    LR    R7,R5       SAVE REG 5
         SRL   R7,1        DIVIDE BY TWO
         SLL   R7,1        MULTIPLY BY 2
         CR    R7,R5       SEE IF WE LOST A BIT
         BNE   SAVECH      NE  MEANS NOT ON HW BOUNDARY
         LA    R7,WORK     LOAD THE ADDRESS OF THE CHAR STRING
         SR    R6,R7       COMPUTE THE NUMBER OF CHARS IN STRING
         BNP   LOAD2       DO NOT PROCESS 0 LENGTH STRINGS
         STH   R6,SYMLEN+2  STORE THE LENGTH IN THE SYMBOL RTN
         L     R15,=V(SYMBOL)  LOAD THE ADDRESS FOR THE SYMBOL ROUTI
         LA    R1,SYMLIST   LOAD THE ARGUMENT LIST ADDRESS
   SPACE  3
         TM    1(R2),X'01'   TEST FOR CHARACTER SIZE
         BZ    SMALL
         MVC   HGT,LARGE      MUST NEED LARG CHARABTERS
         MVC   HHGT,HLARGE
         B     SIMBOL        GO CALL SYMBOL
SMALL    MVC   HGT,BASIC     NEED SMALL SIZE CHARACTERS
         MVC   HHGT,HBASIC
SIMBOL   SE    F0,HHGT       ADJUST FOR THE CHARACTER SPACING
         SE    F2,HHGT       DIFFERENCE BETWEEN GOULD & 2250
         STE   F0,X          STORE THE X POSITION VALUE
         STE   F2,Y          STORE THE Y POSITION VALUE
```

```
         BALR  R14,R15          CALL SYMBOL TO PLOT CHAR STRING
         LA    R1,WLST
         L     R15,=V(WHERE)    LOCATE BEAM POSITION
         BALR  R14,R15            AFTER PLOTTING
         LE    F0,X             RELOAD THE X POSITION REGISTER
         LE    F2,Y             RELOAD THE Y POSITION REGISTER
         AE    F0,HHGT
         AE    F2,HHGT
LOAD2    LR    R2,R5            UPDATE THE R2 ADDRESS
         B     CKNEXT
      EJECT
**********************************************************************
*                    PROCESS VECTORS/POINTS
**********************************************************************
    SPACE  3
VECTORS  MVI   VSW1+1,C'0'  SET INCR MODE BYPASS SWITCH ON
         MVI   VSW2+1,C'0'  SET POINT LINE SWITCH TO LINE MODE
         CLI   1(R2),X'02'  TEST FOR A GEVM CODE
         BE    OPENSW2+4    IF SO SWITCHERS ARE OK
         BL    *+8  IFLCW WE HAVE POINTS WITH HW ABS VALUES
         MVI   VSW1+1,X'0'  SET SWITCH FOR INCR MODE
         CLI   1(R2),X'05'  TEST FOR POINT MODE INCR TYPE
         BE    *+8
OPENSW2  MVI   VSW2+1,X'00'   SET SWITCH FOR POINT PLOT MODE
         LA    R2,2(R2)       INCREMENT R2
         CR    R2,R4          CHECK FOR END OF BUFFER
         BH    EOBERR         IF SO PROCESS THE ERROR
         CLI   0(R2),X'2A'    CHECK FOR A NEW GRAPHICS ORDER
         BE    GORDER         IF SO GO PROCESS NEW COMMAND
         SR    R6,R6
         SR    R7,R7          CLEAR RR'S 6&7
VSW1     NOP   NOTING  SWITCH FOR BYPASSING INCR VECTOR MODE
         LH    R6,0(R2)       LOAD THE X,Y,BEAM VALUES INTO R6
         SRDA  R6,9           SHIFT BEAM AND Y VALUES INTO R7
         SDR   F4,F4          CLEAR FLOAT REG 4
         MVI   FLTX,X'6A'     SET FOR A POSITIVE INCREMENT
         SLA   R6,2           MULTIPLY BY 4
         BH    FLTX-4         IF POSITIVE ADD IT INTO THE X REG
         BE    FLTX+10
         LPR   R6,R6          IF NEGATIVE MAKE IT POSITIVE
         MVI   FLTX,X'6B'     AND SET THE FLOAT FOR A SUBTRACTION
         ST    R6,FLTMP+4     STORE THE VALUE INTO TEMP FLOAT AREA
FLTX     AD    F4,FLTMP       FLOAT THE INCR VALUE INTO F4
         ME    F4,RU2SL       CONVERT TO PROPER CSALE SIZE
         AER   F0,F4          ADD IT TO THE X POSITION REG
         SDR   F6,F6          CLEAR FLOAT REG 6
         SLL   R7,1           REMOVE EXTRA BIT FROM Y VALUE
         SLDL  R6,7           MOVE Y VALUE INTO R6
         SLL   R6,25          SHIFT SIGN BIT INTO POSITION
         MVI   FLTY,X'6A'     SET FLOAT FOR A POS INCR
         SRA   R6,23          PROPAGATE SIGN BIT DOWN
         BH    FLTY-4         IF ALREADY POSITIVE GO PROCESS IT
         BE    FLTY+10
         MVI   FLTY,X'6B'     SET FOR MINUS INCREMENT
         LPR   R6,R6          RELOAD R6 WITH A POSITIVE VALUE
         ST    R6,FLTMP+4     STORE THE VALUE INTO TEMP FLOAT AREA
FLTY     AD    F6,FLTMP       FLOAT THE Y INCR VALUE INTO F6
         ME    F6,RU2SL    SCALE IT OF R SCAN LINES NOT RASTER UNITS
         AER   F2,F6       ADD THE INCREMENT TO THE Y POSITION REG
         SR    R6,R6          CLEAR REG 6
         SLDL  R6,1           MOVE BEAM INDICATOR INTO R6
```

```
         B      SET4PLT         GO PLOT THE VECTOR
NOTINC   LH     R7,0(R2)        LOAD THE X VALUE INTO R7
         SLDA   R6,18           MOVE BEAM INDICATOR INTO REG 6
         SRL    R7,18           READJUST THE X VALUE
         ST     R7,FLTMP+4      STORE THE VALUE INTO TEMP FLOAT AREA
         SDR    F0,F0           CLEAR THE X POSITION REGISTER
         AD     F0,FLTMP        LOAD IN THE NEW X POSITION
         ME     F0,RU2SL        SCALE IT FOR SCAN LINES NOT RASTER UNITS
         LA     R2,2(R2)        UPDATE THE REG 2 ADDR
         SDR    F2,F2           CLEAR THE Y POSITION REGISTER
         LH     R7,0(R2)        LOAD THE Y VALUE INTO R7
         ST     R7,FLTMP+4      STORE THE VALUE INTO TEMP FLOAT AREA
         AD     F2,FLTMP        LOAD Y VALUE INTO THE Y POSITION REG
         ME     F2,RU2SL        SCLE IT FOR SCAN LINES NOT RASTER UNITS
SET4PLT  STE    F0,X            STORE THE X POSITION
         STE    F2,Y            STORE THE Y POSITION
         L      R15,=V(PLOT)    LOAD ADDRESS OF THE PLOT ROUTINE
         LA     R1,PLTLST       LOAD THE ARGUMENT LIST ADDRESS
         LA     R7,2            LOAD A 2 INTO REG 7
VSW2     NOP    LINES           SKIP IF WE AREA IN LINE MODE
         MVI    IPEN+3,X'3'     SET IPEN TO OFF
         BALR   R14,R15         GO MOVE TO THE POINT FOR PLOT
         LE     F0,X            RELOAD THE X VALUE
         LE     F2,Y            RELOAD THE Y REG
         LTR    R6,R6           Q. A POINT TO BE PLOTTED?
         BNE    OPENSW2+4       A. NO. PROCESS NEXT VECTOR
         LA     R1,PLTLST2      A. YES. DOUBLE WIEGHT POINTS
         L      R15,=V(PLOT)
         BALR   R14,R15
         B      LOADFXY         GO RELOAD FLOATING REGS
LINES    AR     R7,R6           COMPUTE THE IPEN CODE 1=
         ST     R7,IPEN         SAVE IT IN THE IPEN VALUE AREA
         LA     R1,PLTLST
         L      R15,=V(PLOT)
         BALR   R14,R15         GO CALL PLOT ROUTINE
LOADFXY  LE     F0,X            RELOAD THE FLOATING REG F0
         LE     F2,Y            RELOAD THE FLOATING REG F2
         B      OPENSW2+4       GO TO PROCESS THE NEXT VECTOR
    EJECT
***********************************************************************
*                  DATA DECLARATIONS I
***********************************************************************
GSRTADD  DC     F'0'
*
OFFSET   DC     XL4'00003FFF'
*
SYMLEN   DC     H'0'
         DC     H'0'
*
ZERO     DC     F'0'
NEG1     DC     F'-1'
NEG3     DC     F'-3'
TWO      DC     F'2'
*
    SPACE   3
***********************************************************************
*                       ARGUMENT LIST FOR
*                             SYMBOL
***********************************************************************
    SPACE   3
SYMLIST  DC     A(X)
```

```
         DC    A(Y)
HEIGHT   DC    A(HGT)
         DC    A(WORK)
         DC    A(ZERO)
         DC    X'80'
         DC    AL3(SYMLEN)
     EJECT
***********************************************************************
*                   THREE SEPARATE ARGUMENT LISTS
*                            FOR PLOT
***********************************************************************
    SPACE   3
PLTLST   DC    A(X)
         DC    A(Y)
         DC    X'80'
         DC    AL3(IPEN)
    SPACE   2
PLTLST2  DC    A(X)
         DC    A(Y)
         DC    A(TWO)
         DC    X'80'
         DC    AL3(NEG1)
         SPACE 2
PLTLST3  DC    A(FQUART)
         DC    A(FQUART)
         DC    X'80'
         DC    AL3(NEG3)
    SPACE   3
***********************************************************************
*                     PROGRAM STASH AREA
*
***********************************************************************
    SPACE   3
TABLE    DC    F'0'
START    DC    F'0'
     EJECT
***********************************************************************
*                    DATA DECLARATIONS II
***********************************************************************
LARGE    DC    E'0.193878'       WIDTH OF LARGE CHARACTER
HLARGE   DC    E'0.096939'
BASIC    DC    E'0.128378'       WIDTH OF BASIC CHARACTER
HBASIC   DC    E'0.064189'
RU2SL    DC    E'0.002319'
X        DC    F'0'
Y        DC    F'0'
IPEN     DC    F'0'
NINES    DC    E'999.0'
WORK     DC    20CL4'
HGT      DC    F'0'
HHGT     DC    F'0'
         CNOP  0,8
FLTMP    DC    XL8'4E00000000000000'
***********************************************************************
*                  ARGUMENT LIST FOR PLOTS
***********************************************************************
PLTS     DC    A(XMAX)
         DC    X'80'
         DC    AL3(YMAX)
***********************************************************************
*                    DATA DECLARATIONS III
```

```
*********************************************************************
XMAX     DC      E'10.0'
*
YMAX     DC      E'10.0'
*
FQUART   DC      E'0.25'
         SPACE   3
*********************************************************************
*                     ARGUMENT LIST FOR RESERV
*********************************************************************
RSVARGS  DC      X'80'
         DC      AL3(K40)
*********************************************************************
*                     DATA DECLARATIONS IV
*********************************************************************
K40      DC      F'40000'
SVELEN   DC      A(72)
*********************************************************************
*                     ARGUMENT LIST FOR WHERE
*********************************************************************
WLST     DC      A(X)
         DC      A(Y)
         DC      X'80'
         DC      AL3(WORK)
     EJECT
*
DONE     MVI     RETCODE,X'0'   CLEAR THE RETURN CODE VALUE
Z999     LA      R1,PLTLST
         LA      R11,999
         ST      R11,IPEN           END PLOT
         SR      R11,R11
         ST      R11,X
         ST      R11,Y
         L       R15,=V(PLOT)
         BALR    R14,R15
         SR      R1,R1  CLEAR REG1
         L       R15,=V(CLSOUT)   LOAD ADDR OF CLSOUT ROUTINE
         BALR    R14,R15  GO CLOSE THE GOULD ROUTINES
         LA      R1,0(R13)
         L       R0,SVELEN
         L       R13,4(R13) LOAD CALLING PROGS RETURN ADDRESS
         SVC     10   EXECUTE THE FREEMAIN SVC
         LM      R14,R12,12(R13)  RELOAD CALLING PROGS REGISTERS
         MVI     12(R13),X'FF'   SET RETURN INDICATOR
         LA      R15,0   SET RETURN CODE
         ORG     *-1  RE-ORIGIN FOR PUTTING RETCODE INTO MVI INST
RETCODE  DS      CL1  DEFINE SAACE FOR THE RETURN CODE IN MVI INST
         BR      R14  RETURN TO THE CALLING PROGRAM
EOBERR   MVI     RETCODE,X'4'
         B       DONE+4
      SPACE  4
         END
```

APPENDIX D

JCL AND DATA REQUIRED TO CREATE 67 USAF AND 70 ARMY SURVEY MEMBERS AND R67 USAF AND R70 ARMY REGRESSION MEMBERS OF THE COMBIMAN ANTHROPOMETRIC DATA BASE

```
//CBMAM     JOB HESS
//JOBLIB    DD DSN=COMBIMAN.LOADLIB,DISP=SHR
//CBMAM     EXEC PGM=CBMAM
//FT02F001  DD DSN=COMBIMAN.ANTHDATA,DISP=SHR
//FT02F001  DD DSN=COMBIMAN.ANTHDATA,UNIT=DISK,DISP=(NEW,CATLG),
//             VOL=SER=DISK01,SPACE=(248,2000),
//             DCB=(BLKSIZE=248,LRECL=248,RECFM=FB)
//FT05F001  DD DDNAME=SYSIN
//FT06F001  DD SYSOUT=A
//FT07F001  DD SYSOUT=B
//SYSUDUMP  DD SYSOUT=A
//SYSIN     DD *
+INT
```

```
MEMBER NAME   USAF
          +ACD R67 USAF    C  17   24   12                                                   00010000
            1 WEIGHT              LB    1         1                                          00010100
            2 SITTING HEIGHT      IN          1   1                                          00010200
            3 EYE HGT/SITTING     IN          1                                              00010300
            4 ACROMION HGT/SIT    IN              1                                          00010400
            5 KNEE HGT/SITTING    IN          1   1                                          00010500
            6 BUTTOCK-KNE LGTH    IN          1   1                                          00010600
            7 SHOULDR-ELB LGTH    IN              1                                          00010700
            8 ELBOW-GRIP LGTH     IN          1                                              00010800
            9 THUMB-TIP REACH     IN          1                                              00010900
           10 BIACROMIAL BRDTH    IN              1                                          00011000
           11 BIDELTIOD BRDTH     IN    1                                                    00011100
           12 HIP BREADTH         IN              1                                          00011200
           13 HIP BREADTH/SITT    IN    1                                                    00011300
           14 CHEST DEPTH         IN    1         1                                          00011400
           15 FOOT LENGTH         IN              1                                          00011500
           16 HAND LENGTH         IN              1                                          00011600
           17 ELBOW-WRIST LGTH    IN              1                                          00011700
            1  2          0.02669  32.05275    1.11161    7.84536-114.20831   19.05910   00011800
            1  2  1  1.0          0.0          0.0                                           00011900
            1  2  2  0.0          1.0000000    0.0                                           00012000
            1  2  4               .731        -2.779522                                      00012100
            1  2  5               .404         7.133844                                      00012200
            1  2  6               .333        11.566906                                      00012300
            1  2  7               .247         5.090541                                      00012400
            1  2 10  0.0131732 0.1105000     9.69417                                         00012500
            1  2 12  0.0279173 0.0043000     8.87957                                         00012600
            1  2 14  0.0313031-0.1665000    10.32958                                         00012700
            1  2 15  0.0069724 0.1246000     4.65466                                         00012800
            1  2 16               .117         3.232277                                      00012900
            1  2 17               .193         4.728337                                      00013000
            1  3          0.02287  27.69656    1.08116    7.45657 -54.02761   19.52156   00013100
            1  3  1  1.0          0.0          0.0                                           00013200
            1  3  2               0.979        5.484241                                      00013300
            1  3  4               0.737        0.55118                                       00013400
            1  3  5               .403         9.114155                                      00013500
            1  3  6               .349        12.661392                                      00013600
            1  3  7               .260         5.80613                                       00013700
            1  3 10  0.0141614 0.0857000    10.84526                                         00013800
            1  3 12  0.0276189 0.0093000     8.75802                                         00013900
            1  3 14  0.0304921-0.1567000     9.41976                                         00014000
            1  3 15  0.0075236 0.1215000     5.46532                                         00014100
            1  3 16               .113         3.921252                                      00014200
            1  3 17               .173         6.295263                                      00014300
            1  5          0.02470  17.66583    0.82738   11.76173 -64.61144   18.05449   00014400
            1  5  1  1.0          0.0          0.0                                           00014500
            1  5  2               .656        22.28342                                       00014600
            1  5  4               .510        12.838557                                      00014700
            1  5  5  0.0          1.0000000    0.0                                           00014800
            1  5  6               .851         5.096415                                      00014900
            1  5  7               .516         2.622629                                      00015000
            1  5 10  0.0125630 0.1442000    10.68774                                         00015100
            1  5 12  0.0282283-0.0081000     9.16118                                         00015200
            1  5 14  0.0301690-0.1347000     7.37230                                         00015300
            1  5 15  0.0030315 0.2947000     3.64651                                         00015400
            1  5 16               .215         2.603144                                      00015500
            1  5 17               .443         2.082673                                      00015600
            1  6          0.03156  18.29394    0.82109   12.81257-131.08463   16.53998   00015700
```

MEMBER NAME USAF

1	6	1	1.0	0.0	0.0				00015800
1	6	2		.460	25.744043				00015900
1	6	4		.358	15.523591				00016000
1	6	5		.725	4.712589				00016100
1	6	6	0.0	1.0000000	0.0				00016200
1	6	7		.442	3.641725				00016300
1	6	10	0.0158071	0.0097000	13.06010				00016400
1	6	12	0.0267283	0.0412000	8.26378				00016500
1	6	14	0.0293819	-0.0795000	6.44566				00016600
1	6	15	0.0033780	0.2192000	4.84350				00016700
1	6	16		.165	3.598416				00016800
1	6	17		.327	4.031488				00016900
1	8		0.01212	11.75517	0.58148	13.73200	-16.71660	19.56918	00017000
1	8	1	1.0	0.0	0.0				00017100
1	8	2		.906	24.125936				00017200
1	8	4		.676	14.669262				00017300
1	8	5		1.206	5.240147				00017400
1	8	6		1.043	9.326753				00017500
1	8	7		.715	4.244086				00017600
1	8	10	0.0132520	0.2362000	10.46027				00017700
1	8	12	0.0276150	0.0176000	6.81113				00017800
1	8	14	0.0287244	-0.1528000	6.78696				00017900
1	8	15	0.0053740	0.4061000	4.08147				00018000
1	8	16		.359	2.547239				00018100
1	8	17		.785	.929132				00018200
1	9		0.03029	26.35823	1.42612	5.66767	-5.58512	19.50635	00018300
1	9	1	1.0	0.0	0.0				00018400
1	9	2		.330	26.251916				00018500
1	9	4		.250	16.133626				00018600
1	9	5		.439	8.074787				00018700
1	9	6		.410	10.816876				00018800
1	9	7		.291	4.952746				00018900
1	9	10	0.0136611	0.0805000	11.11438				00019000
1	9	12	0.0281693	-0.0046000	9.13904				00019100
1	9	14	0.0279646	-0.0362000	5.94550				00019200
1	9	15	0.0063701	0.1298000	5.43332				00019300
1	9	16		.119	3.759635				00019400
1	9	17		.243	4.125976				00019500
11	2		0.34507	30.12037	1.20046	0.22536	10.72527	0.96934	00019600
11	2	1	16.9568	0.0	-148.083				00019700
11	2	2	0.0	1.0000000	0.0				00019800
11	2	4		.731	-2.779522				00019900
11	2	5		.404	7.133644				00020000
11	2	6		.333	11.566906				00020100
11	2	7		.247	5.090541				00020200
11	2	10	0.4600000	0.1104000	3.24965				00020300
11	2	12	0.4129000	0.1303000	1.26161				00020400
11	2	14	0.4789000	-0.0286000	1.61592				00020500
11	2	15	0.0873000	0.1599000	3.12040				00020600
11	2	16		.117	3.232277				00020700
11	2	17		.193	4.726337				00020800
11	3		0.30610	26.05530	1.14619	0.22134	11.93960	0.97466	00020900
11	3	1	16.9568	0.0	-148.083				00021000
11	3	2		0.979	5.484241				00021100
11	3	4		0.737	0.55118				00021200
11	3	5		.403	9.114155				00021300
11	3	6		.349	12.661592				00021400
11	3	7		.260	5.86613				00021500

MEMBER NAME USAF

11	3	10	0.4715600	0.0869000	4.31225				00021600
11	3	12	0.4201000	0.1234000	1.97291				00021700
11	3	14	0.4806000	-0.0381000	1.74185				00021800
11	3	15	0.0945000	0.1566000	3.85737				00021900
11	3	16		.113	3.921252				00022000
11	3	17		.173	6.295263				00022100
11	5		0.33166	15.65472	0.92347	0.35026	11.30361	0.94902	00022200
11	5	1	16.9568	0.0	-148.083				00022300
11	5	2		.653	22.28342				00022400
11	5	4		.510	12.83855				00022500
11	5	5	0.0	1.0	0.0				00022600
11	5	6		.851	5.098415				00022700
11	5	7		.510	2.822829				00022800
11	5	10	0.4540000	0.1333000	4.48622				00022900
11	5	12	0.3965000	0.1854000	2.28117				00023000
11	5	14	0.4478000	0.0640000	-0.25567				00023100
11	5	15	0.0376000	0.3172000	2.96457				00023200
11	5	16		.215	2.803144				00023300
11	5	17		.443	2.082673				00023400
11	6		0.46362	14.97491	0.95564	0.41724	9.07114	0.90058	00023500
11	6	1	16.9568	0.0	-148.083				00023600
11	6	2		.460	25.74404				00023700
11	6	4		.358	15.52359				00023800
11	6	5		.725	4.712589				00023900
11	6	6	0.0	1.0000000	0.0				00024000
11	6	7		.442	3.641725				00024100
11	6	10	0.4949000	0.0068000	8.47457				00024200
11	6	12	0.3472000	0.2399000	1.58527				00024300
11	6	14	0.4105000	0.1268000	-1.15616				00024400
11	6	15	0.0265000	0.2516000	4.15668				00024500
11	6	16		.165	3.598418				00024600
11	6	17		.327	4.031488				00024700
11	8		0.15866	10.64653	0.61644	0.39855	13.46951	0.97702	00024800
11	8	1	16.9568	0.0	-148.083				00024900
11	8	2		.906	24.12593				00025000
11	8	4		.676	14.66926				00025100
11	8	5		1.206	5.240147				00025200
11	8	6		1.043	9.326753				00025300
11	8	7		.715	4.244086				00025400
11	8	10	0.4066000	0.2348000	4.02853				00025500
11	8	12	0.4209000	0.2326000	2.66465				00025600
11	8	14	0.4596000	0.0593000	0.10506				00025700
11	8	15	0.0768000	0.4518000	3.03617				00025800
11	8	16		.359	2.547239				00025900
11	8	17		.785	.929132				00026000
11	9		0.43448	23.36423	1.50431	0.18032	13.29244	0.96911	00026100
11	9	1	16.9568	0.0	-148.083				00026200
11	9	2		.330	26.25191				00026300
11	9	4		.250	16.13362				00026400
11	9	5		.439	8.074787				00026500
11	9	6		.410	10.81867				00026600
11	9	7		.291	4.952746				00026700
11	9	10	0.4659000	0.0744000	4.83476				00026800
11	9	12	0.4237000	0.0799000	3.34054				00026900
11	9	14	0.4512000	0.0413000	-0.21794				00027000
11	9	15	0.0767000	0.1521000	4.37728				00027100
11	9	16		.119	3.759635				00027200
11	9	17		.243	4.125976				00027300

MEMBER NAME USAF

13	2		0.46318	29.79372	1.17767	0.24312	5.96088	0.65322	00027400
13	2	1	20.2776	0.0	-127.757				00027500
13	2	2	0.0	1.0000000	0.0				00027600
13	2	4		.731	-2.779522				00027700
13	2	5		.404	7.133844				00027800
13	2	6		.323	11.566906				00027900
13	2	7		.247	5.090541				00028000
13	2	10	0.1935000	0.1669000	7.03065				00028100
13	2	12	0.7167000	0.0498000	1.39459				00028200
13	2	14	0.5539000	-0.0551000	3.43517				00028300
13	2	15	0.1106000	0.1527000	3.39454				00028400
13	2	16		.117	3.232277				00028500
13	2	17		.193	4.726337				00028600
13	3		0.40811	25.79650	1.12810	0.23757	7.30887	0.86072	00028700
13	3	1	20.2776	0.0	-127.757				00028800
13	3	2		0.979	5.484241				00028900
13	3	4		0.737	0.55118				00029000
13	3	5		.403	9.114155				00029100
13	3	6		.349	12.661392				00029200
13	3	7		.260	5.86613				00029300
13	3	10	0.2134000	0.1408000	8.37065				00029400
13	3	12	0.7207000	0.0468000	1.67072				00029500
13	3	14	0.5537000	-0.0621000	3.39681				00029600
13	3	15	0.1206000	0.1491000	4.09600				00029700
13	3	16		.113	3.921252				00029800
13	3	17		.173	6.295263				00029900
13	5		0.44387	15.34930	0.89625	0.37738	6.59500	0.62641	00030000
13	5	1	20.2776	0.0	-127.757				00030100
13	5	2		.656	22.28342				00030200
13	5	4		.510	12.83855				00030300
13	5	5	0.0	1.0	0.0				00030400
13	5	6		.851	5.098415				00030500
13	5	7		.516	2.822829				00030600
13	5	10	0.1694000	0.2281000	8.50694				00030700
13	5	12	0.7157000	0.0540000	2.04980				00030800
13	5	14	0.5175000	0.0253000	1.40055				00030900
13	5	15	0.0417000	0.3146000	3.11505				00031000
13	5	16		.215	2.803144				00031100
13	5	17		.443	2.082673				00031200
13	6		0.64324	14.20918	0.89041	0.46605	3.79715	0.75792	00031300
13	6	1	20.2776	0.0	-127.757				00031400
13	6	2		.460	25.74404				00031500
13	6	4		.358	15.52359				00031600
13	6	5		.725	4.712589				00031700
13	6	6	0.0	1.0	0.0				00031800
13	6	7		.442	3.669475				00031900
13	6	10	0.1909000	0.1234000	10.25960				00032000
13	6	12	0.7041000	0.0552000	2.09503				00032100
13	6	14	0.4824000	0.0720000	0.76467				00032200
13	6	15	0.0173000	0.2545000	4.33329				00032300
13	6	16		.165	3.598418				00032400
13	6	17		.327	4.031488				00032500
13	8		0.20220	10.85128	0.61001	0.40891	9.21256	0.66749	00032600
13	8	1	20.2776	0.0	-127.757				00032700
13	8	2		.906	24.12593				00032800
13	8	4		.676	14.66926				00032900
13	8	5		1.206	5.240147				00033000
13	8	6		1.043	9.326753				00033100

MEMBER NAME USAF

13	8	7		.715	4.244086				00033200
13	8	10	0.2023000	0.3355000	8.37363				00033300
13	8	12	0.7182000	0.1055000	1.73571				00033400
13	8	14	0.5230000	0.0277000	1.48880				00033500
13	8	15	0.0913000	0.4426000	3.15125				00033600
13	8	16		.359	2.547239				00033700
13	8	17		.785	.929132				00033800
13	9		0.51279	23.98611	1.49653	0.17133	9.46316	0.86504	00033900
13	9	1	20.2776	0.0	-127.757				00034000
13	9	2		.330	26.25191				00034100
13	9	4		.250	16.13382				00034200
13	9	5		.439	8.074787				00034300
13	9	6		.410	10.81687				00034400
13	9	7		.291	4.952746				00034500
13	9	10	0.2075000	0.1224000	9.07808				00034600
13	9	12	0.7238000	0.0308000	2.14232				00034700
13	9	14	0.5110000	0.0345000	0.56138				00034800
13	9	15	0.1050000	0.1479000	4.40562				00034900
13	9	16		.119	3.759835				00035000
13	9	17		.243	4.157416				00035100
14	2		0.21453	34.61474	1.23950	0.07920	6.74695	0.75510	00035200
14	2	1	21.4816	0.0	-33.422				00035300
14	2	2	0.0	1.0000000	0.0				00035400
14	2	4		.731	-2.779522				00035500
14	2	5		.404	7.133844				00035600
14	2	6		.333	11.566906				00035700
14	2	7		.247	5.090541				00035800
14	2	10	0.2285000	0.1957000	6.64776				00035900
14	2	12	0.5291000	0.1614000	2.12145				00036000
14	2	14	1.0000000	0.0	0.0				00036100
14	2	15	0.1146000	0.1704000	3.28406				00036200
14	2	16		.117	3.232277				00036300
14	2	17		.193	4.726337				00036400
14	3		0.16752	30.25192	1.18027	0.06858	7.46870	0.75520	00036500
14	3	1	21.4816	0.0	-33.422				00036600
14	3	2		0.979	5.484241				00036700
14	3	4		0.737	0.55118				00036800
14	3	5		.403	9.114155				00036900
14	3	6		.349	12.661392				00037000
14	3	7		.260	5.86613				00037100
14	3	10	0.2413000	0.1746000	8.14076				00037200
14	3	12	0.5379000	0.1796000	2.96665				00037300
14	3	14	1.0000000	0.0	0.0				00037400
14	3	15	0.1229000	0.1691000	4.06737				00037500
14	3	16		.113	3.921252				00037600
14	3	17		.175	6.295253				00037700
14	5		0.36704	18.41054	0.94189	0.21947	4.65601	0.72634	00037800
14	5	1	21.4816	0.0	-33.422				00037900
14	5	2		.656	22.28342				00038000
14	5	4		.510	12.63855				00038100
14	5	5	0.0	1.0000000	0.0				00038200
14	5	6		.851	5.098415				00038300
14	5	7		.516	2.822629				00038400
14	5	10	0.1770000	0.2529000	8.77199				00038500
14	5	12	0.4860000	0.2164000	4.42040				00038600
14	5	14	1.0000000	0.0	0.0				00038700
14	5	15	0.0317000	0.3254000	3.23744				00038800
14	5	16		.215	2.603144				00038900

```
MEMBER NAME  USAF
       14  5 17                .443        2.082673                                         00039000
       14  6          0.58391  18.14341    0.96724    0.29754    2.57675    0.69645    00039100
       14  6  1 21.4816        0.0        -33.422                                           00039200
       14  6  2                .460        25.74404                                         00039300
       14  6  4                .358        15.52359                                         00039400
       14  6  5                .725        4.712589                                         00039500
       14  6  6  0.0           1.0000000    0.0                                             00039600
       14  6  7                .442        3.641725                                         00039700
       14  6 10  0.1769000 0.1600000  10.52173                                              00039800
       14  6 12  0.4156000 0.2606000   3.67241                                              00039900
       14  6 14  1.0000000 0.0         0.0                                                  00040000
       14  6 15 -0.0026000 0.2634000   4.40554                                              00040100
       14  6 16                .165        3.598418                                         00040200
       14  6 17                .327        4.031488                                         00040300
       14  8          0.16629  12.23530    0.62395    0.23936    6.35689    0.74412    00040400
       14  8  1 21.4816        0.0        -33.422                                           00040500
       14  8  2                .906        24.12593                                         00040600
       14  8  4                .676        14.66926                                         00040700
       14  8  5                1.206       5.240147                                         00040800
       14  8  6                1.043       9.326753                                         00040900
       14  8  7                .715        4.244086                                         00041000
       14  8 10  0.2075000 0.3683000   8.92597                                              00041100
       14  8 12  0.5211000 0.2741000   5.05256                                              00041200
       14  8 14  1.0000000 0.0         0.0                                                  00041300
       14  8 15  0.0721000 0.4625000   3.53542                                              00041400
       14  8 16                .359        2.547239                                         00041500
       14  8 17                .785        .929132                                          00041600
       14  9          0.51986  26.59757    1.51637    0.12216    5.79212    0.73567    00041700
       14  9  1 21.4816        0.0        -33.422                                           00041800
       14  9  2                .330        26.25191                                         00041900
       14  9  4                .250        16.13382                                         00042000
       14  9  5                .439        3.074787                                         00042100
       14  9  6                .410        10.81667                                         00042200
       14  9  7                .291        4.952746                                         00042300
       14  9 10  0.2008000 0.1334000   9.87646                                              00042400
       14  9 12  0.5202000 0.0914000   5.97084                                              00042500
       14  9 14  1.0000000 0.0         0.0                                                  00042600
       14  9 15  0.0690000 0.1574000   4.99869                                              00042700
       14  9 16                .119        3.759635                                         00042800
       14  9 17                .243        4.125976                                         00042900
      +ADD 67 USAF      1  17  24  12  25  RC7 USAF                                         00043000
       1 2 3 5101520253035404550556065707580859095979899                                    00043100
       1 WEIGHT              LB 173.60680 21.434704127561326313562140151406915155           00043200
      155271585616156164371670816974172421751317792180641839718741191521955 1            00043300
      2018321076216622209422773                                                             00043400
       2 SITTING HEIGHT    IN 36.685532 1.2501624 3394 3424 3444 3470 3511 3539             00043500
       3562 3582 3600 3617 3633 3649 3665 3681 3698 3715 3733 3755 3775 3801                00043600
       3833 3880 3910 3931 3962                                                             00043700
       3 EYE HGT/SITTING  IN 31.669176 1.1671142 2917 2950 2971 2996 3036 3060              00043800
       3087 3106 3123 3138 3153 3168 3183 3198 3213 3229 3246 3265 3280 3311                00043900
       3343 3390 3421 3443 3478                                                             00044000
       4 ACROMION HGT/SIT IN 24.03821  1.123410  2142 2177 2197 2224 2263 2269              00044100
       2310 2327 2343 2358 2373 2387 2401 2415 2430 2445 2461 2479 2499 2522                00044200
       2551 2594 2620 2639 2666                                                             00044300
       5 KNEE HGT/SITTING IN 21.95673    .98041    1973 1998 2015 2037 2071 2095             00044400
       2113 2129 2143 2157 2169 2182 2194 2206 2219 2231 2245 2260 2277 2296                00044500
       2322 2360 2386 2405 2436                                                             00044600
       6 BUTTOCK-KNE LGTH IN 23.76431  1.06204   2136 2165 2183 2207 2244 2269              00044700
```

```
MEMBER NAME  USAF
          2289 2306 2322 2336 2350 2363 2376 2389 2402 2416 2431 2447 2465 2486  00044800
          2514 2557 2587 2610 2648                                               00044900
          7 SHOULDR-ELB LGTH IN 14.15382   .674011  1265 1281 1291 1306 1329 134500045000
          1357 1368 1379 1388 1397 1406 1414 1423 1432 1441 1451 1461 1473 1486  00045100
          1503 1528 1544 1555 1573                                               00045200
          8 ELBOW-GRIP LGTH  IN 13.86133  .63554    1247 1261 1270 1283 1304 131900045300
          1331 1342 1351 1360 1369 1377 1385 1393 1401 1410 1419 1429 1440 1452  00045400
          1469 1493 1509 1521 1540                                               00045500
          9 THUMB-TIP REACH  IN 31.62047  1.56498   2804 2846 2872 2908 2964 300100045600
          3030 3056 3079 3100 3120 3139 3158 3178 3198 3218 3240 3264 3291 3322  00045700
          3364 3427 3469 3502 3555                                               00045800
         10 BIACROMIAL BRDTH IN 16.03454   .764311  1418 1441 1456 1475 1505 152500045900
          1541 1554 1566 1576 1586 1596 1605 1614 1624 1633 1643 1654 1666 1680  00046000
          1698 1726 1744 1758 1782                                               00046100
         11 BIDELTIOD BRDTH  IN 18.99046  1.00841   1667 1696 1714 1737 1772 179500046200
          1814 1830 1844 1858 1871 1884 1896 1909 1922 1936 1951 1967 1985 2005  00046300
          2032 2071 2097 2115 2142                                               00046400
         12 HIP BREADTH      IN 13.88310  .741637   1221 1241 1254 1271 1297 131400046500
          1328 1339 1350 1359 1368 1377 1386 1395 1404 1413 1423 1434 1447 1462  00046600
          1482 1515 1537 1555 1584                                               00046700
         13 HIP BREADTH/SITT IN 14.87821   .90583   1286 1310 1325 1345 1375 139600046800
          1412 1426 1439 1451 1462 1473 1484 1495 1506 1518 1531 1545 1561 1580  00046900
          1605 1644 1670 1690 1723                                               00047000
         14 CHEST DEPTH      IN  9.65481   .75788    796  814  825  841  867  88500047100
           900  913  925  936  946  956  965  975  985  994 1005 1016 1029 1043  00047200
          1062 1090 1110 1124 1149                                               00047300
         15 FOOT LENGTH      IN 10.64335   .468125   957  970  979  989 1006 101700047400
          1025 1033 1039 1046 1052 1057 1063 1069 1.75 1081 1088 1095 1103 1113  00047500
          1125 1144 1156 1165 1180                                               00047600
         16 HAND LENGTH      IN  7.52310   .322807   679  688  693  700  711  71900047700
           725  730  735  739  743  747  751  755  760  764  769  774  779  786  00047800
           794  807  815  821  830                                               00047900
         17 ELBOW-WRIST LGTH IN 11.81      .56      1052 1068 1077 1090 1110 112400048000
          1134 1143 1151 1159 1166 1173 1180 1187 1194 1201 1209 1218 1227 1236  00048100
          1253 1274 1288 1299 1316                                               00048200
```

APPENDIX E

JCL AND DATA REQUIRED TO CREATE THE COMBIMAN CREW STATION DATA BASE MEMBER A7E-01

```
//CBMCM    JOB HESS                                                     00001000
//JOBLIB   DD DSN=COMBIMAN.LOADLIB,DISP=SHR                              00001100
//CBMCM    EXEC PGM=CBMCM                                               00001200
//FT01F001 DD DSN=COMBIMAN.CRSTDATA,UNIT=DISK,DISP=(NEW,CATLG),         00001300
//            VOL=SER=DISK01,SPACE=(368,2000),                          00001310
//            DCB=(BLKSIZE=368,LRECL=368,RECFM=FB)                      00001320
//FT05F001 DD DDNAME=SYSIN                                              00001400
//FT06F001 DD SYSOUT=A                                                  00001500
//FT07F001 DD SYSOUT=B                                                  00001600
//SYSUDUMP DD SYSOUT=A                                                  00001700
//SYSIN    DD *                                                         00001800
$INT
$ACC A7E-01     46  46   0.0   0.0   0.0 F L U
  1LMIPAN         16  2975   000   594  2975  1475   594  3134  1475  1339
  3259   957  1930  3320   450  2214  3320   000  2300
  2RMIPAN         16  2975   000   594  2975 -1475   594  3134 -1475  1339
  3259  -957  1930  3320  -450  2214  3320   000  2300
  3FWDLHCON       15  2623   925   289  2623  1875   289  2831  1801   408
  2979  1718   593  2979   928   593
  4LHCCN          14  2609   925   276  -840   925   276  -840  2301   276
  2609  2000   275
  5AFTLHCON       14  -335   850   276  -853   850   276  -853  2352   276
  -340  2300   275
  6FWDRHCON       15  2623  -925   289  2623 -1875   289  2631 -1801   408
  2979 -1718   593  2979  -928   593
  7RHCCN          14  2609  -925   276  -840  -925   276  -840 -2353   276
  2609 -2000   275
  8CNSWLFSD       14  2610   925   276  -336   925   276  -336   925  -932
  2610   925  -932
  9CNSWLSRH       14  2610  -925   276  -336  -925   276  -336  -925  -932
  2610  -925  -932
 10UWPRLPAN       14  2974  -478   593  2947  -308   463  2947   308   463
  2979   478   593
 11LWPRLPAN       14  2947  -308   463  2904  -245   264  2904   245   264
  2949   308   463
 12THRTLLSD       16  1996  1393   790  1931  1393   765  1882  1393   559
  1969  1388   513  2089  1388   693  2069  1388   763
 13THRTLFWD       14  2092  1393   694  1973  1393   518  1973  1141   516
  2089  1138   693
 14THRTLRSD       16  1996  1141   790  1931  1141   765  1882  1141   559
  1969  1138   513  2089  1138   693  2069  1138   763
 15THRTLAFT       14  1931  1141   765  1882  1141   559  1882  1393   559
  1929  1388   763
 16THRTPAFT       14  1996  1141   790  1931  1141   765  1931  1393   765
  1999  1388   793
 17THRTLTPC       14  2066  1141   760  1996  1141   790  1996  1393   790
  2069  1388   763
 18THRTPFWD       14  2092  1141   694  2066  1141   760  2066  1393   760
  2089  1388   693
 19THRLGAFT       14  1905  1216   548  1783  1216   276  1783  1316   276
  1909  1313   543
 20THRLGFWD       14  1950  1216   527  1838  1216    27  1838   131    27
  1949  1318   525
 21GLSHTP         14  2090    00  2602  5718    00  1776  5718    00  1776
  2090    00  2604
 22HUDSCRN        14  2209   374  3226  2209  -374  3226  2901  -374  2447
  2901   374  2447
 23CWFLLL         16  1730  1400  1494  1994  1389  2466  2208  1135  2995
  2208  1136  2995  1994  1390  2466  1730  1401  1494
```

```
 24CWFMLL        16  2208  1135  2995  2261  1000  3128  2365   500  3389
 2365   501  3389  2261  1001  3128  2208  1136  2995
 25CWFCL         16  2365   500  3389  2384   000  3433  2365  -500  3389
 2365  -500  3390  2384    00  3434  2365   500  3390
 26CWFMRL        16  2365  -500  3389  2261 -1000  3128  2208 -1135  2995
 2208 -1136  2995  2261 -1001  3128  2365  -501  3389
 27CWFLRL        16  2208 -1135  2995  1994 -1389  2466  1730 -1400  1494
 1730 -1401  1494  1994 -1390  2466  2208 -1136  2995
 28CWRLLL        16 -1158  1782  1494 -1649  1500  2893 -1830  1200  3409
-1830  1201  3409 -1649  1501  2893 -1158  1783  1494
 29CWRMLL        16 -1830  1200  3409 -1942   900  3730 -2014   600  3934
-2014   601  3934 -1942   901  3730 -1830  1201  3409
 30CWRULL        16 -2014   600  3934 -2054   300  4048 -2067   000  4085
-2067   000  4086 -2054   301  4048 -2014   601  3934
 31CWRURL        16 -2067   000  4085 -2054  -300  4048 -2014  -600  3934
-2014  -601  3934 -2054  -301  4048 -2067   000  4086
 32CWRMRL        16 -2014  -600  3934 -1942  -900  3730 -1830 -1200  3409
-1830 -1201  3409 -1942  -901  3730 -2014  -601  3934
 33CWRLRL        16 -1830 -1200  3409 -1650 -1500  2893 -1158 -1782  1494
-1158 -1783  1494 -1649 -1501  2893 -1830 -1201  3409
 34CWLBL         14  1730  1400  1494  1730  1405  1494 -1158  1787  1494
-1158  1782  1494
 35CWRBL         14  1730 -1400  1494  1730 -1405  1494 -1158 -1787  1494
-1158 -1782  1494
 36CFTRCL        14 -2067   001  4085   550   001  4072   550  -001  4072
-2067  -001  4085
 37CFTMCL        14   550   001  4072  1553   001  3884  1553  -001  3884
  550  -001  4072
 38CFTFCL        14  1553   001  3884  2665   001  3347  2665  -001  3347
 1553  -001  3884
 39WNOSCRN       14  2665   001  3347  5718   001  1776  5716  -001  1776
 2665  -001  3347
 40LRDRPDL       14  3748  1007    85  3748   463    85  3477   463  -653
 3477  1007  -653
 41RRDRPDL       14  3748 -1007    85  3748  -463    85  3477  -463  -653
 3477 -1007  -653
 42FLRLINE       14   391   925  -945  2131   925  -945  2131  -925  -945
  391  -925  -945
 43LHLRSTLN      13  2131   925  -945  4208   925 -1161  4226   925  -945

 44RHLRSTLN      13  2131  -925  -945  4208  -925 -1161  4226  -925  -945

 45CHLRSTLN      14  4226   925  -945  4208   925 -1161  4208  -925 -1161
 4226  -925  -945
 46HUDFACE       14  2090    00  2602  2355    00  2139  3223    00  1741
 3320    00  2300
AFTPTLT       0  00 -1108  2600  3125
AFTPTREA      0  00 -2956     0  2275
AFTPTRT       0  00 -1108 -2600 -9913
EMERPOWO      0  00  2589  1675   654
FCCATG        0  00  2059  1250   800
FCHKDOWN      0  00  2379 -1602   504
FCHKUP        0  00  2649 -1602   793
FCLDGGRU      0  00  2669  1043   800
FCRUDPDA      0  00  2784     0   114
FCSTKRPA      0  00  1647    34  1126
FCSTKRPM      0  00  2027    34  1151
FCTFADJ       0  00  1509   975   350
FCTHRTLA      0  00  1116  1266   704
```

```
FCTHRTLM       0   00   1593   1266    857
FIADAI         0   00   2449    543   2802
FIHUD          0   00   2799     0.   2779
FISTBYCD       0   00   3183  -1575   1618
FWDPTLTD       0   00   4059   3500   2275
FWDPTRTU       0   00   4059  -3500   3475
IMPGSSRC       0   00   4869      0    -90
LONGLT         0   00    611   1542   1284
MAP CASE       0   00   -890  -1810    684
MSCANREL       0   00   1111  -1442    904
NUTRLSRP       0   00      1      0      0
RUDPDLAB       0   00   2869    725   -456
RUDPDLAN       0   00   3119    725   -506
RUDPDLAT       0   00   3369    725   -456
RUDPDLFB       0   00   3669    725   -506
RUDPDLFN       0   00   3919    725   -556
RUDPDLFT       0   00   4209    725   -506
RUDPDRAB       0   00   2869   -725   -456
RUDPDRAN       0   00   3119   -725   -506
RUDPDRAT       0   00   3369   -725   -456
RUDPDRFB       0   00   3669   -725   -506
RUDPDRFN       0   00   3919   -725   -556
RUDPDRFT       0   00   4169   -725   -506
SNDSEATE       0   00     -6      0    -71
SRP DOWN       0   00     59      0   -190
SRP UP         0   00    -90      0    287
STDPOSLH       0   00  27059      0  -9913
STDPOSRH       0   00  27059      0  -9913
STDPOSLF       0   00  27059      0  -9913
STDPOSRF       0   00  27059      0  -9913
STDPOSEY       0   00  27059      0  -9913
WSARMREL       0   00   2908      0    389
WSBPC          0   00   2259   1350    475
$ACDD A7--SEAT     5     1    0.0    0.0    0.0 F L U
001SBTP           14  -435   -750   2359      1   -750      0      1    750      0
   -440    750  2363
002BKHDRST        14  -495   -350   3535   -350   -650   2655   -350    650   2655
   -495    350  3535
003SPANMID        14    00   -750     00     00    750     00   1279    750    125
   1279   -750   125
004SPANFWDL       14  1277    225    131   1277    750    131   1720    750    212
   1719    228   215
005SPANFWDR       14  1277   -225    131   1277   -750    131   1720   -750    212
   1719   -228   215
DESEYE            00   0.0    0.0    0.0
$END
/*
//                                                                      00110003
```

APPENDIX F

THE JCL AND DATA REQUIRED TO CREATE THE COMBIMAN VISIBILITY DATA BASE MEMBER A7E-01

```
//CBMVM     JOB HESS
//JOBLIB    DD DSN=COMBIMAN.LOADLIB,DISP=SHR
//CBMVM     EXEC PGM=CBMVM
//FT05F001 DD DDNAME=SYSIN
//FT06F001 DD SYSOUT=A
//FT07F001 DD SYSOUT=B
//FT09F001 DD DSN=COMBIMAN.VISDATA,UNIT=DISK,DISP=(NEW,CATLG),
//              VOL=SER=DISK01,SPACE=(240,2000),
//              DCB=(BLKSIZE=240,LRECL=240,RECFM=FB)
//SYSUDUMP DD SYSOUT=A
//SYSIN     DD *
&INT
&ACD A7E-01     2 270.6   0.0 99.15 A R L FS 8L WL
001WINDSCREEN, FRONT TOP        32
 22763  -584 12535
 22379  -551 12324                                                       104
 22098  -546 12157                                                       104
 21893  -519 12059                                                       104
 21579  -487 11876                                                       104
 21314  -427 11735                                                       103
 21109  -362 11616                                                       103
 20914  -281 11584                                                       103
 20914   000 11584                                                       103
 20914   281 11584                                                       102
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